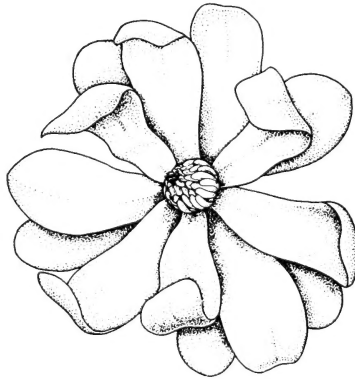






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A Taxonomic Revision of *Bulbophyllum* (Orchidaceae) 2. Sections *Altisceptrum* and *Hirtula**

J.J. VERMEULEN

Singapore Botanic Gardens
Singapore 259569

Abstract

Bulbophyllum sect. *Altisceptrum* and sect. *Hirtula* (Orchidaceae) are revised. Both sections are distributed in South and East Asia, and Malesia. The two sections together include 49 species and 1 subspecies. The investigations leading to this paper yielded 25 new species. Many of these have been described in precursors to this revision, eight are described here as new: *B. sororculum*, *B. lanuginosum*, *B. grotianum*, *B. scaphiforme*, *B. comberipictum*, *B. ochthodes*, *B. debrincatae*, and *B. pilosum*. All species (except one) are illustrated.

Introduction

The present revision is a continuation of Vermeulen (1993); consequently, the introductory chapters 2 to 6 in that first instalment of the series largely apply to this revision. The numbering of the species is also continued. This revision therefore starts with species number 111. Whereas the sections of *Bulbophyllum* revised in the first instalment occur almost exclusively in East Malesia, sect. *Altisceptrum* and sect. *Hirtula* are predominantly from South and East Asia, and West Malesia. The species in both sections have racemose inflorescences.

Section *Altisceptrum* includes 9 species and 1 subspecies. These are large plants that are rather similar to the racemose series of sect. *Sestochilus*, but they generally differ in having long and narrow, 1-veined petals. On the whole, the delimitation of the species is rather straightforward, although a re-evaluation of *B. disjunctum sensu* Vermeulen (1991: 21) led to its division into two distinct species and one subspecies. *Bulbophyllum gymnopus* Hook.f. is included in the section; it had recently been placed in *Drymoda* Lindl. by Garay *et al.* (1994: 641).

Section *Hirtula* comprises 40 species. These are generally characterised by the presence of 1-celled hairs on the flowers, particularly on the petals and the lip. Most species are rather rare in nature, and only sparsely represented in collections. This tends to make a taxonomist's life deceptively easy, but in fact the reliability of the revision suffers because the delimitation of the species relies on the taxonomist's intuition rather than on the evaluation of a representative set of specimens. Only one of

* continued from *Orchid Monographs* 7 (1993): 1–324

the commoner species, *B. hirtulum* Ridl., was found to display more than average infraspecific variability. Apart from this, confusion about the identity of *B. nigrescens* Rolfe, *B. nigripetalum* Rolfe, and *B. secundum* Hook.f. (see Seidenfaden, 1979) has been resolved, and a re-evaluation of the Thai material of *B. penicillium* Par. & Rchb.f. in Rchb.f. has led to its description as a new species.

Although this revision includes only 8 new species, no fewer than 25 species out of the 49 included have been described as new by the present author over the last 10 years. The present revision presents the first full plates of many of these.

Extinct species. Several species are marked in this revision as 'probably extinct'. This is defined here as not having been found for at least 50 years, following the IUCN definition of the term 'extinct'. However, many supposedly extinct plant species that were collected long ago occur in areas that are only rarely visited by botanists. The species may be extinct, particularly if they were found in lowland areas, but they may still be present, unnoticed, in remote remnants of Asia's forests.

Section *Altisceptrum* J.J. Sm.

Bulbophyllum sect. *Altisceptrum* J.J. Sm., Bull. Jard. Bot. Buitenzorg, s. 2, 13 (1914)
34. – LECTOTYPE: *Ephippium elongatum* Blume [= *Bulbophyllum elongatum* (Blume) Hassk.], here designated.

Rhizome creeping, scales usually covering rhizome, pseudobulbs and leaf bases before disintegrating. *Roots* predominantly sprouting below the pseudobulbs. *Pseudobulbs* 1-leafed, not or hardly laterally flattened, wrinkling along pre-determined longitudinal lines or in a random pattern with age. *Inflorescence* with many flowers. *Rhachis* not swollen when compared to the peduncle. *Floral bracts* patent to reflexed. *Flowers* spirally arranged, sometimes partly in whorls (*penduliscapum*, *elongatum*), not resupinate, or resupinate (*gymnopus*), not fully opening, many simultaneously. *Pedicel* and *ovary*: basal node usually more or less flush with the surface of the rhachis, or on a stump up to 2 mm high (*gymnopus*). *Median sepal* porrect or somewhat recurved with an incurved top part, 3-veined. *Lateral sepals* free, recurved to spreading, 3-veined. *Petals* linear, often gradually tapering from a wide base, or elliptic to obovate with a linear, long drawn-out top part (*nemorale*), margins usually erose-denticulate, sometimes entire or papillose-ciliolate; the lower margin often decurrent along the column foot, 1-veined, or 2—3-veined (*nemorale*). *Lip* usually without a median slit, rarely with a median slit (*fulvibulbum*), glabrous or finely papillose locally, thin to thick but not fleshy. *Column*:

stigma not protruding at its base; column foot elongated in several species, leaving a gap between the median and lateral sepals that is not filled entirely by the petals (distinctly present in *gymnopus*; moderately distinct in *elongatum*, slight in *placochilum* and *lissoglossum*); column foot otherwise without accessories. *Stelidia* distinct, triangular to linear, often subulate, often with a small tooth along the upper margin and a narrow wing along the lower, at the base. *Anther* abaxially with a papillose ridge near its base; frontal part not or hardly projecting, front margin glabrous to papillose. *Pollinia* 4; the inner \pm half as long as the outer or longer, flattened on both sides; the outer flattened on one side. Stipes absent.

Distribution. Bhutan (1 taxon), India (1), Thailand (2), Peninsular Malaysia (3), Sumatra (2), Java (1), Borneo (7, of which 5 are endemics), Philippines (3), New Guinea (2).

Delimitation of the section. Section *Altisceptrum* is very similar to the racemose series of sect. *Sestochilus*. The main distinctive characters lie in the petals: although slightly varying in shape, they all consist of a wide basal part tapering into a long, linear top part. They usually have one vein.

While most have petals with 3 or more veins, some racemose species of sect. *Sestochilus* also have 1-veined petals: *Bulbophyllum pachyphyllum* J.J. Sm., *B. tahanense* Carr, *B. univenum* J.J. Verm., and *B. wrayi* Hook.f. These have distinctly shorter and wider petals than sect. *Altisceptrum*, and entire and glabrous margins. *Bulbophyllum nemorale* L.O. Williams, of sect. *Altisceptrum*, has petals with three veins, and *B. elongatum* (Blume) Hassk., has petals with entire and glabrous margins. On account of overall similarity, both have been included in sect. *Altisceptrum*.

Garay *et al.* (1994) transferred *Bulbophyllum gymnopus* to the genus *Drymoda* Lindl., on account of the presence of a gap between the petals and the lateral sepals. *Drymoda* otherwise includes minute plants with deciduous leaves, 1-flowered inflorescences, and flowers with a lip of a different shape, and a column with projecting teeth along the lower margin of the stelidia. *Bulbophyllum gymnopus* is not obviously similar; it fits better in sect. *Altisceptrum*. The displacement of the basal node of the pedicel, the resupinate flowers, and the wide gap between the petals and lateral sepals are unique characters for the species within the section; the last character occurs, less distinctly, in several other species of sect. *Altisceptrum*.

Bulbophyllum phreatiopse J.J. Verm., here included in sect. *Hirtula*, has petals with papillose-ciliolate margins, but these are shorter and wider than in sect. *Altisceptrum*.

In spite of these species, sect. *Altisceptrum* possesses an overall distinctness when compared with sect. *Sestochilus*, mainly through its rather small, spidery flowers. It is therefore best to maintain it as a separate

group. J.J. Smith originally listed three species: *Bulbophyllum elongatum* (Blume) Hassk., *B. penduliscapum* J.J. Sm., and *B. pachyphyllum* J.J. Sm. The latter is best included in the racemose series of sect. *Sestochilus* for reasons given above. Otherwise J.J. Smith's concept of the section is followed.

Monophyly. It seems reasonable to assume monophyly *a priori* on account of a rather marked overall similarity of the species. Section *Sestochilus* seems the most likely outgroup; however, sect. *Altisceptrum* may well be nested within sect. *Sestochilus*. If this were true, its status as a separate section would leave *Sestochilus* as a paraphyletic group.

Cultivation. Five species have been cultivated in recent years. The general rules for growing *Bulbophyllum* apply here: semi-shade, a substrate with some 'soft' organic matter that is never allowed to dry out entirely, high air humidity and abundant air movement. High air humidity seems particularly important except, possibly, for *B. gymnopus*. The plants grow rather easily on tree-fern slabs, with some sphagnum or other soft material among the roots when mounted to help them settle, or in baskets with a potting mix containing sufficient soft organic matter. However, *B. penduliscapum* is growing well outdoors in Singapore in a small pot mainly filled with medium-sized charcoal chips. *Bulbophyllum disjunctum* often occurs abundantly in its natural habitat but is rarely found in flower. It may continue this habit of shy flowering when taken into cultivation.

Key to Species of *Bulbophyllum* sect. *Altisceptrum*

1. Leaf tip rounded to obtuse (check undamaged leaves)
 2. Inflorescence pendulous. Veins of rhizome bracts persistent as a whorl of stiff, erect bristles around the pseudobulb 111. **B. penduliscapum**
 2. Inflorescence erect to patent. Veins of rhizome bracts more or less decaying with the bract itself
 3. Lateral sepals 5—8 mm long. Flowers resupinate: column foot directed towards the base of the inflorescence 112. **B. gymnopus**
 3. Lateral sepals 10—22 mm long. Flowers not resupinate: column foot directed towards the tip of the inflorescence
 4. Median sepal 2—3.2 mm wide. Lateral sepals 2.2—3.8 mm wide 113. **B. farinulentum**
 4. Median sepal 3.4—5.3 mm wide. Lateral sepals 4.5—5 mm wide 114. **B. fulvibulbum**
1. Leaf tip acute to acuminate

- 5. Petals with 3 veins, the laterals sometimes not reaching the base. Petals with an elliptic to obovate basal half and a linear top half ... 115. **B. nemorale**
- 5. Petals with 1 vein. Petals gradually tapering from a wide base, or a from widest part close to the base
 - 6. Keels on the adaxial side of the lip at the proximal end with two erect to antrorse, obtuse knobs 116. **B. disjunctum**
 - 6. Keels on the adaxial side of the lip without knobs, or no keels present
 - 7. Lip orbicular to transversely elliptic in outline (do not spread out!) 117. **B. placoecilum**
 - 7. Lip ± triangular in outline, with or without a projecting, linguiform top
 - 8. Median sepal 12.5—17.5 mm long. Lip 2.4—3 mm wide. Leaves in flowering plants 6—16 cm wide 118. **B. elongatum**
 - 8. Median sepal 8—11.2 mm long. Lip 1—1.8 mm wide. Leaves in flowering plants 2.1—4.5 cm wide .. 119. **B. lissoglossum**

111. *Bulbophyllum penduliscapum* J.J. Sm. — Fig. 1, plate 1.

Bulbophyllum penduliscapum J.J. Sm., Icon. Bogor. 2 (1903) 101. – TYPE: Indonesia, Sumatra, northern part, *Heldt s.n.* (BO, holo., not seen).

Bulbophyllum macrophyllum F. Kraenzl., Bot. Jahrb. Syst. 34 (1905) 249. – TYPE: Malaysia, Sarawak, *Beccari PB 3113* (FI, lecto.; K, isolecto., indicated by Vermeulen, 1991), *PB 1344* (FI).

Bulbophyllum jarensense Ames, Orch. 6 (1920) 301. — TYPE: Philippines, Leyte, Jaro, *Wenzel 761* (PNH holo., destroyed; AMES, K, NY, S, iso.).

Secondary roots erect, growing in dense tufts surrounding the plant. *Rhizome* 6—10 mm diam., sections between pseudobulbs 1.8—4 cm long; bracts soon withering but veins persistent as a whorl of stiff, erect bristles around the pseudobulbs. *Pseudobulbs* close to distant, discoid, 0.5—0.7 x 0.5—1.2 cm. *Petiole* 11—24 cm. *Leaf blade* elliptic, 21—38 x 7.5—15.5 cm, index (length/width) 1.6—2.8; rounded to obtuse. *Inflorescence* a rather dense raceme, with the flowers ± in whorls of 4—8 towards the tip of the rhachis, pendulous, 23—65 cm, 50—250-flowered. *Peduncle* 9—14 cm, bracts 5—6, the longest 40—60 mm long. *Rhachis* 12—58 cm. *Floral bracts* triangular, 4—7 x 1.5—2 mm, acute. *Pedicel* and *ovary* 3—5 mm long. *Median sepal* ovate to triangular, 8—12 x 1.5—2 mm, index 4.7—6.7; acute to acuminate, margins entire; glabrous or finely papillose locally, base broadly attached; rather thin. *Lateral sepals* slightly oblique, 8—12.5 x 1—2.5 mm, index 4.1—8; otherwise as the median sepal. *Petals* porrect, often falcate, gradually tapering from a wide base, 5—9 x 0.7—0.9(—1.2) mm,

index 7.1—11.3; acute, margins finely erose; glabrous or finely papillose locally, base broadly attached; rather thin. *Lip* recurved in the basal half, triangular, 2—3.5 x 1—1.6 mm, index 2—2.5; obtuse, margins entire or slightly erose and somewhat finely papillose; rather thin; adaxially concave near the base, with 2 distinct, obtuse ridges diverging towards the base and running to about half-way up the lip, space in between channelled, surface glabrous except for a papillose strip proximally along the median line, abaxially with a weak, rounded ridge up to about 1/3 of the length of the lip, surface glabrous. *Column* 2.2—3 mm long. *Stelidia* falcate or not, subulate, 0.8—1.2 mm long, acute, often with a small, antrorse, deltoid, obtuse to acute tooth along the upper margin.

Colours: Sepals pale yellow at the base, yellow at the tip, with large dark purple spots. Petals translucently yellow with similar spots. Lip brownish at the base, yellow at the tip. Column yellowish. Flowers sweetly fragrant, attractive to flies.

Habitat & ecology: Found in *kerangas* forest, forest on limestone, and lower montane forest. Epiphyte growing in large clumps on tree trunks and major branches, catching leaf litter in the dense tangle of secondary roots. Alt. 300–1100 m. Flowering in Feb—Apr, Nov, Dec.

Distribution: MALAYSIA: Peninsula (2 living plants seen); Sarawak (3 specimens seen); Sabah (8). PHILIPPINES: Leyte (2). INDONESIA: Sumatra (2).

Notes: Unmistakable, even without flowers, because of the clustered pseudobulbs, the persistent fibres of the rhizome scales, and the tufts of erect catch-roots. Well-grown, flowering plants can be quite spectacular.

Some variability occurs in the stelidia; these are porrect in some specimens (e.g. the type of *B. jarensis*) but strongly curved downwards in others (e.g. the type of *B. macrophyllum*).

112. *Bulbophyllum gymnopus* Hook.f. – Fig. 2.

Bulbophyllum gymnopus Hook.f., Fl. Brit. Ind. 5 (1890) 764; id., Hooker's Icon. Pl. 21 (1892) t. 2040; Seidenf., Dansk Bot. Ark. 33, 3 (1979) 100. — *Phyllorchis gymnopus* (Hook.f.) O. Kuntze, Rev. Gen. Pl. 2 (1891) 677. — *Drymoda gymnopus* (Hook.f.) Garay, Hamer & Siegerist, Nordic J. Bot. 14 (1994) 641; Seidenfaden, Opera Bot. 124 (1995) 47, **colour photograph pl. 9b**. — TYPE: Bhutan, Griffith 5133 (K, lecto., indicated by Seidenfaden, 1979); India, Khasia Hills, Griffith 5134 (K, W); India, Assam, Jowai, Clarke 42549 (K).

Figure 1. *Bulbophyllum penduliscapum* J.J. Sm. (111) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, above: abaxial side, below: adaxial side; g. Pollinia, above: single pair, below: two pairs. – All from Vermeulen 1147 (living plant).

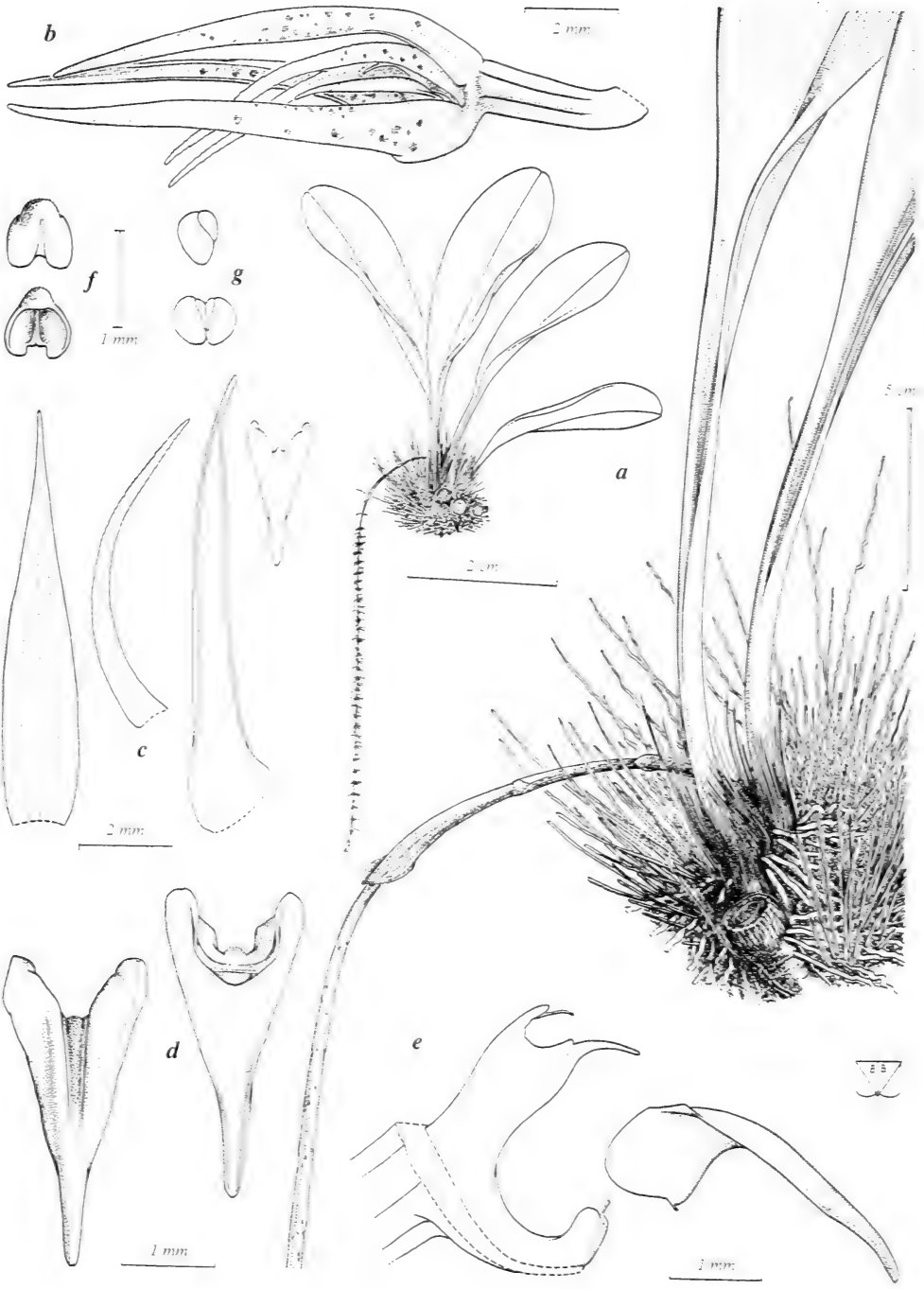


Figure 1. *Bulbophyllum penduliscapum* J.J. Sm. (111)

Rhizome 2.5—4.5 mm diam., sections between pseudobulbs 3—22 cm long; bracts, including veins, soon withering. *Pseudobulbs* distant, ovoid, 1.2—4 x 0.8—1.5 cm. *Petiole* 1.0—3.5 cm. *Leaf blade* elliptic, 4.8—17 x 1—3.2 cm, index (length/width) 4.3—6.3; obtuse. *Inflorescence* a lax raceme, erect to patent, 7—23 cm, 7—28-flowered. *Peduncle* 1.8—7 cm; bracts 4—6, the longest 5—17 mm long. *Rhachis* 5—17 cm. *Floral bracts* ovate to triangular, 1.8—3.5 x 1—1.8 mm, acute. *Flowers* resupinate. *Pedicel* and *ovary* 8—10 mm long, basal node on a 1—2 mm-long stump. *Median sepal* ovate to triangular, 4.5—7 x 1.4—2.2 mm, index 2.2—3.9; emarginate, rounded to acute, margins entire; glabrous, base narrowly attached; thin, surface glabrous or slightly papillose towards the tip abaxially. *Lateral sepals* falcate, 5—8 x 1.4—2.5 mm, index 3—4.3; obtuse, otherwise as the median sepal. *Petals* recurved, falcate, linear with a wide base, 3—5.5 x 0.4—0.7 mm, index 4.2—11; obtuse to acuminate, margins erose towards the tip; glabrous, base broadly attached; thin. *Lip* recurved slightly below half-way, linguiform, 2—4 x 0.8—1.3 mm, index 1.6—5; obtuse, margins entire, glabrous or finely papillose locally; thick, surface ± glabrous; adaxially concave near the base, often with 2 inconspicuous, obtuse ridges about half-way up the lip, space in between the two ridges somewhat channelled; abaxially with a distinct, deeply emarginate ridge up to about 1/3 of the length of the lip. *Column* 2—3 mm long, foot elongated so that a gap exists between the petals and the lateral sepals. *Stelidia* triangular, 0.4—1 mm long, acute, often with an inconspicuous, deltoid, obtuse tooth along the upper margin.

Colours: Rhizome scales in young shoots densely spotted with purplish brown. Sepals and petals white, pale greenish white or yellowish. Lip yellow or orange. Column white to orange. Flowers with an unpleasant smell.

Habitat & ecology: Epiphytic or lithophytic in evergreen forest (Seidenfaden, 1979), in montane forest. Alt. 600-2000 m. Flowering in Jan—Mar and Oct—Dec.

Distribution: BHUTAN (1 specimen seen), INDIA: Sikkim (1); Khasia Hills (1); Naga Hills (1); Assam (5). THAILAND (2).

Notes. The densely spotted scales of the young shoots are very characteristic in this species.

Figure 2. *Bulbophyllum gymnopus* Hook.f. (112) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, above: adaxial side, below: abaxial side; g. Pollinia, left: two pairs, right: single pair. – a. From *King's collectors s.n.* (herbarium specimen); b—e. From *Seidenfaden & Smitinand GT 8643* (spirit sample); f. From *Herb. Hooker f. s.n.* (herbarium specimen); g. From *Hort. Kew EN 596-68* (spirit sample).

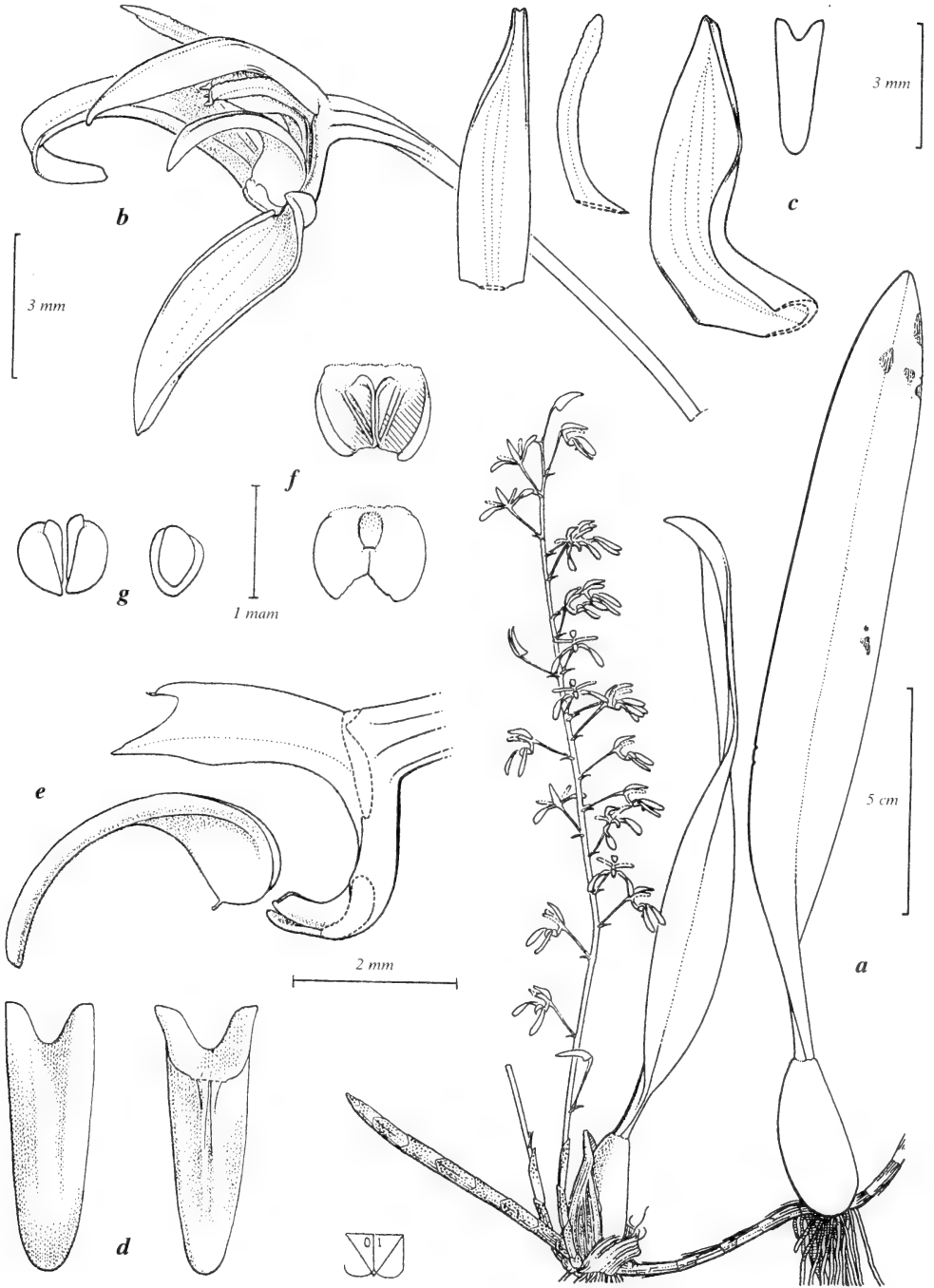


Figure 2. *Bulbophyllum gymnopus* Hook.f. (112)

113. *Bulbophyllum farinulentum* J.J. Sm.

Rhizome 4—8 mm diam., sections between pseudobulbs 1.2—5 cm long; bracts, including veins, soon withering. *Pseudobulbs* close to distant, ovoid, 0.8—2.2 x 0.8—2.2 cm. *Petiole* 2.5—18 cm. *Leaf blade* elliptic to obovate, 8.5—27 x 3—7.5 cm, index (length/width) 2.2—4.2; rounded to obtuse. *Inflorescence* a lax to dense raceme, erect to patent, 19—55 cm, 5—150-flowered. *Peduncle* 10—25 cm; bracts 5—6, the longest 18—40 mm long. *Rhachis* 3.5—22 cm. *Floral bracts* ovate to triangular, 6.8—12 x 1.5—2 mm, acute. *Flowers* not resupinate. *Pedicel* and *ovary* 4—15 mm long. *Median sepal* ovate to triangular, 9.5—19 x 2—3.2 mm, index 4.2—8.7; acute, margins entire, \pm glabrous, base broadly attached; rather thin; adaxially finely papillose to pubescent except for the basal part. *Lateral sepals* 10—22 x 2.2—3.8 mm, index 3.9—8.8; otherwise as the median sepal. *Petals* recurved, tapering from a wide base, 6.5—13.5 x 0.9—1.6 mm, index 4—10.4; acute to acuminate, margins \pm entire, papillose to ciliate, base rather narrowly attached; thin, top somewhat thickened; adaxially finely papillose to pubescent except for the basal part. *Lip* recurved in the basal half, \pm triangular, 2.8—4.6 x 1—1.7 mm, index 2.1—3; subacute, margins entire, finely papillose locally; thick; adaxially slightly concave near the base, with 3 ridges: 2 distinct, obtuse ridges proximally diverging and often protruding like two retrorse, conical, obtuse knobs and distally running parallel up to about 2/3—3/4 of the length of the lip, space in between the two ridges deeply channelled and proximally with an inconspicuous to rather distinct, rounded median ridge with longitudinal rows of minute papillae on its crest, adaxial surface otherwise finely papillose locally; abaxially with rather inconspicuous, retuse to truncate ridge up to about 1/2 of the length of the lip, surface glabrous. *Column* 2.3—3 mm long. *Stelidia* narrowly triangular to subulate, 0.8—1.2 mm long, acute, often with a small, antrorse, deltoid, obtuse to acute tooth along the upper margin; often with an inconspicuous, deltoid, obtuse to broadly rounded wing along the lower margin, at the base

Notes: The material allows two subspecies to be distinguished, mainly on account of the size of the vegetative parts and the number of flowers in

Figure 3. *Bulbophyllum farinulentum* J.J. Sm. ssp. *farinulentum* (113a) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, left: abaxial side, right: adaxial side; g. Pollinia, left: single pair, right: two pairs. — *Bulbophyllum farinulentum* J.J. Sm. ssp. *densissimum* (Carr) J.J. Verm. (113b) – h. Lip, left: adaxial side, right: abaxial side; i. Column and lip, lateral view. – a—e. From *Hort. Leiden* 20771; f, g. From *Hort. Leiden* 26544 (all spirit samples); h. From *Synge* 98 (herbarium specimen); i. From *Hort. Leiden* 914076 (spirit sample).



Figure 3; a—g. *Bulbophyllum farinulentum* J.J. Sm. ssp. *farinulentum* (113a);
h—i. *Bulbophyllum farinulentum* J.J. Sm. ssp. *densissimum* (Carr) J.J. Verm. (113b)

the inflorescence. Further collecting, however, may reveal intermediate forms.

Vermeulen (1991: 21) incorrectly regarded this as synonymous with *B. disjunctum*. The differences are given below the latter.

Key to the subspecies

1. Inflorescence 5—25-flowered. Flowers in a lax raceme
..... a. **subsp. farinulentum**
1. Inflorescence 60—150-flowered. Flowers in a dense raceme
..... b. **subsp. densissimum**

a. subsp. farinulentum – Fig. 3.

Bulbophyllum farinulentum J.J. Sm., Bull. Jard. Bot. Buitenzorg, s. 3, 2 (1920) 87. —
TYPE: Indonesia, Sumatra, Kerinci, *Jacobson cult. 1413* (*Leg. Groenenveldt*)
(BO, holo., not seen).

Bulbophyllum noeanum Kerr, Bull. Misc. Inform., Kew (1927) 219. – TYPE: Thailand,
Pattani, *Kerr 0113* (K, holo.).

Bulbophyllum disjunctum sensu J.J. Verm., Orch. Borneo 2 (1991) 21 (pro parte), non
Ames & C. Schweinf.

Rhizome 4—6 mm diam. *Pseudobulbs* 1—2.2 x 0.8—2.2 cm. *Petiole* 2.5—10 cm. *Leaf blade*, 8.5—20 x 3—6.5 cm. *Inflorescence* a lax raceme, 19—55 cm, 5—25-flowered. *Rhachis* 3.5—22 cm. *Pedicel* and *ovary* 10—15 mm long. *Lip* 3—4.6 x 1—1.7 mm, often with the ridges proximally protruding like two inconspicuous to distinct knobs. *Stelidia* narrowly triangular, 0.8—1.2 mm, with or without a wing along the lower margin, at the base.

Colours: Sepals and petals (pale) yellow to pale ochre, with red veins. Lip yellow, reddish brown in the centre, or in the apical half.

Habitat & ecology: Epiphyte growing in shaded places in *kerangas* forest in lowland and montane conditions. Alt. 400—2000 m. Flowering in Jan, Feb, May, Sep—Nov.

Distribution: THAILAND: Peninsula (1 specimen seen). MALAYSIA: Peninsula (3); Sarawak (1); Sabah (5). INDONESIA: Sumatra (*vide* J.J. Smith); Kalimantan (1).

b. subsp. densissimum (Carr) J.J. Verm., *stat. nov.* – Fig. 3, plate 2.

Bulbophyllum densissimum Carr, Gard. Bull. Straits Settlements. 8 (1935) 116. – TYPE: Malaysia, Sarawak, Dulit Range, *Synge 98* (K, holo.).

Bulbophyllum disjunctum sensu J.J. Verm., Orch. Borneo 2 (1991) 21 (pro parte), non Ames & C. Schweinf.

Rhizome 6—8 mm diam. *Pseudobulbs* 0.8—1.5 x 0.8—1.5 cm. *Petiole* 9—18 cm. *Leaf blade*, 17—27 x 6.5—7.5 cm. *Inflorescence* a dense raceme, 21—36 cm, 60—150-flowered. *Rhachis* 8—18 cm. *Pedicel* and *ovary* 4—8 mm long. *Lip* 2.8—3.2 x 0.9—1.1 mm, with the ridges proximally protruding like two distinct knobs. *Stelidia* subulate, c. 1.2 mm, \pm without a wing along the lower margin.

Colours: Peduncle bracts yellowish green or red. Flowers entirely creamy yellow, slightly sweetly scented.

Habitat & ecology: Epiphyte in lowland (*kerangas*) forest and probably lower montane forest. Alt. 900 m. and probably higher. Flowering in Mar, Aug.

Distribution: MALAYSIA: Sarawak, Hose Mts. (3 specimens seen).

Notes. Forms of *B. disjunctum* with dense-flowered inflorescences, and occurring in the same area, may look similar but have acute leaves.

114. *Bulbophyllum fulvibulbum* J.J. Verm. — Fig. 4, plate 3.

Bulbophyllum fulvibulbum J.J. Verm., Orch. Borneo 2 (1991) 23. — TYPE: Malaysia, Sabah, Ulu Padas, *Vermeulen 603* (L, holo.; K, iso.).

Rhizome 12—14 mm diam., sections between pseudobulbs 3—4 cm long; bracts, including veins, soon withering. *Pseudobulbs* distant, ovoid, 3—4 x 2.5—2.8 cm. *Petiole* 18—25 cm. *Leaf blade* elliptic to obovate, 37—40 x 8.5—10 cm, index (length/width) 4—4.4, obtuse. *Inflorescence* a rather lax raceme, erect to patent, 28—82 cm, 18—62-flowered. *Peduncle* 13—29 cm; bracts 5—6, the longest 25—50 mm long. *Rhachis* 12—53 cm. *Floral bracts* ovate, 6—15 x 2—3 mm, acute. *Flowers* not resupinate. *Pedicel* and *ovary* 14—25 mm long. *Median sepal* ovate, 10—14.3 x 3.4—5.3 mm, index 2—4.3; obtuse, margins entire, finely papillose or ciliolate towards the tip, base broadly attached; rather thick, top thickened; surface finely papillose towards the tip. *Lateral sepals* 12—17 x 4.5—5 mm, index 2.5—3.6; otherwise as the median sepal. *Petals* recurved, tapering from a wide base, 8—11 x 1.5—2.2 mm, index 4.2—5.4; obtuse, margins entire, finely ciliolate towards the tip, base broadly attached; thick, top thickened, surface adaxially very finely papillose towards the tip. *Lip* recurved slightly below half-way, linguiform, 3.5—4.6 x 1.8—2.5 mm, index 1.7—2.1; obtuse, margins entire, glabrous or finely papillose locally; thick; adaxially slightly concave near the base, with 3 ridges: 2 distinct, obtuse ridges proximally diverging and protruding backwards like two conical, obtuse horns and distally running parallel up to about 2/3 of the length of the lip, space in between the two ridges deeply channelled and with a distinct, narrow, obtuse often finely papillose median ridge with or without a thin median slit over its crest, adaxial surface otherwise glabrous but finely papillose towards the base;

abaxially with a distinct, truncate ridge up to about 1/3 of the length of the lip, surface glabrous. *Column* 3—5 mm long. *Stelidia* triangular, 0.5—1.3 mm long, acute, often with a small, antrorse, deltoid, obtuse to acute tooth along the upper margin.

Colours: Sepals yellow or greenish, adaxially with or without dark red spots, abaxially (sometimes also adaxially) with dark red flushing towards the base. Petals yellow or greenish. Lip yellow or greenish, suffused with dark red towards the base, or lip entirely dull red with a pale green tip. Flowers scentless.

Habitat & ecology: Found as an epiphyte in montane forest with *Agathis*, and in *kerangas* forest growing near the forest floor. Alt. 1100—1500 m. Flowering observed in Oct (Mar, Apr in greenhouse).

Distribution: MALAYSIA: Sarawak, Bario area (1 specimen seen); Sabah, Ulu Padas (3).

Notes: Close to the preceding species; differs in having flowers with wider parts. The median ridge on the adaxial side of the lip is always very distinct, whereas it is usually inconspicuous in *B. farinulentum*.

115. *Bulbophyllum nemorale* L.O. Williams — Fig. 5.

Bulbophyllum nemorale L.O. Williams, Bot. Mus. Leafl., Harvard University 9 (1938) 100. — TYPE: Philippines, Leyte, Jaro, Masaganap, Wenzel 871 (PNH, holo., destroyed; AMES, iso.).

Rhizome 5—8 mm diam., sections between pseudobulbs 2—5 cm long. *Pseudobulbs* close to distant, ovoid, 1—1.3 x 0.8—1.5 cm. *Petiole* 7.5—17 cm. *Leaf blade* elliptic, 15—35 x 4.5—10.5 cm, index (length/width) 2.8—5; acute to acuminate. *Inflorescence* a lax to rather dense raceme, erect to patent, 21—49 cm, 13—40-flowered. *Peduncle* 9—32 cm; bracts 6—8, the longest 20—48 mm long. *Rhachis* 9—19 cm. *Floral bracts* elliptic to ovate, 7—12 x 2—3.5 mm, acute to slightly acuminate. *Flowers* ± secund. *Pedicel* and *ovary* 7—11 mm long. *Median sepal* ovate to triangular, 13—17 x 2.4—4 mm, index 3.5—5.6; acute, margins entire; glabrous, base rather broadly attached; rather thin. *Lateral sepals* falcate, 13—15 x 4.2—5 mm, index 2.6—3.7, base broadly attached; otherwise as the median sepal. *Petals* porrect, falcate, basal half elliptic to obovate, top half linear, 11—14 x 1.5—3, index 4—7.3; acute, margins finely erose ± half-way; glabrous; base rather broadly attached; rather thin with a thickened top part; with 3 veins,

Figure 4. *Bulbophyllum fulvibulbum* J.J. Verm. (114) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: abaxial side, right: adaxial side; e. Column and lip, lateral view; f. Anther, above: abaxial side, below: adaxial side; g. Pollinia, left two pairs, right: single pair. – All from Vermeulen 603 (living plant).

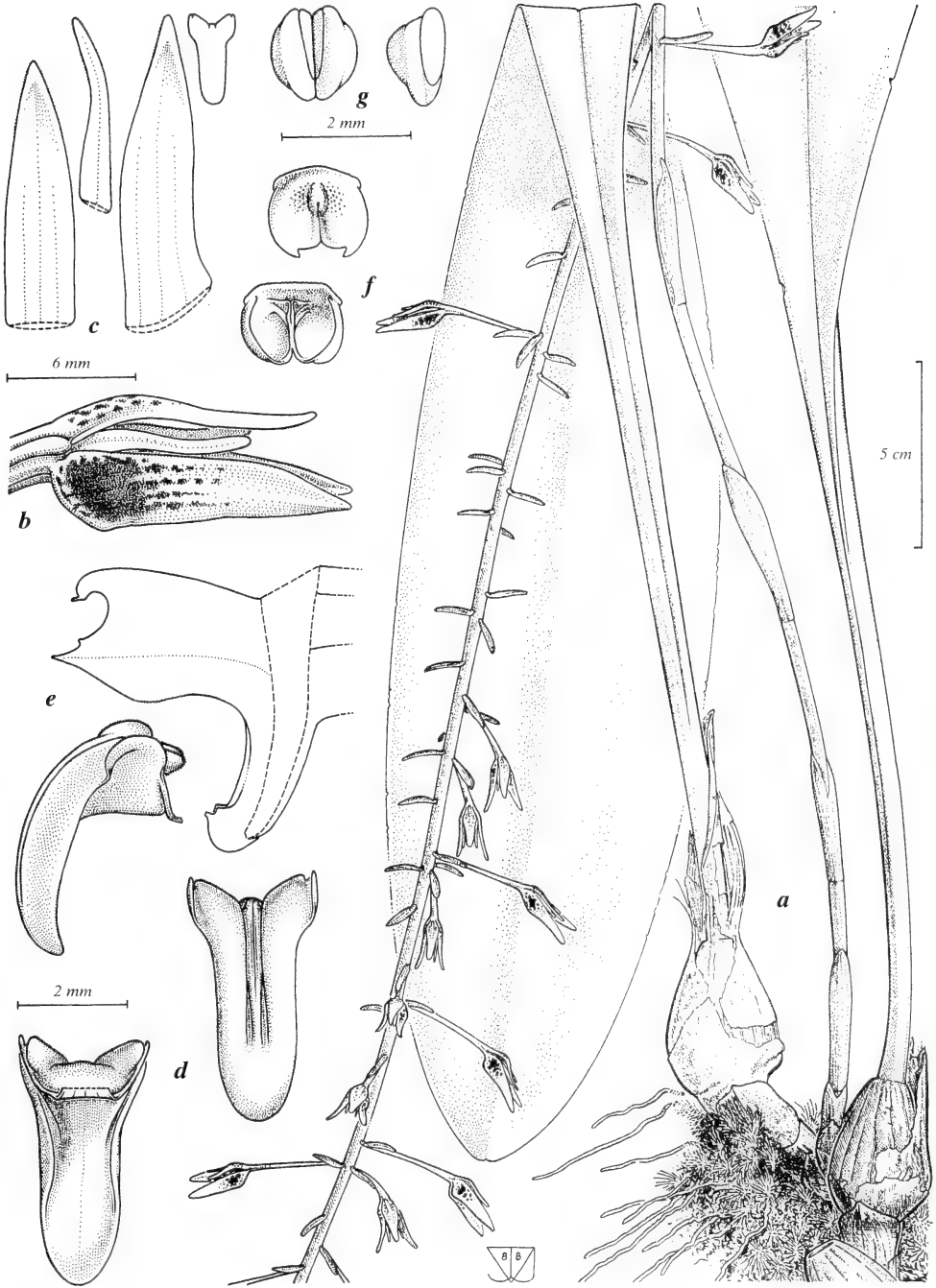


Figure 4. *Bulbophyllum fulvibulbum* J.J. Verm. (114)

the laterals sometimes incomplete and not reaching the base. *Lip* recurved in the basal half, margins entire; glabrous or finely papillose locally; 3-lobed; *midlobe* \pm triangular, 4.2—4.8 x 2.2—3.8 mm, index 1.2—2.2; obtuse, rather thick; adaxially concave and with 2 knob-shaped ridges near the base, with 2 more distinct, obtuse ridges proximally diverging and running \pm parallel from about 1/3 to 2/3 of the length of the lip, the space in between channelled; abaxially with a retuse ridge up to about 1/2—2/3 of the length of the lip; *lateral lobes* attached along the proximal third of the lip, retrorse, ovate to semi-circular, 1.4—1.5 mm high, rounded, margins incurved, thin. *Column* 3—5 mm long. *Stelidia* subulate, 0.8—2.2 mm long, acute, with an antrorse, deltoid, obtuse tooth along the upper margin.

Colours: flowers (pale) yellow with purple spots. Lip green.

Habitat & ecology: Forest, epiphytic or as a terrestrial. Alt. 700—1300 m. Flowering in Feb, May, fruiting in Feb, Apr.

Distribution: PHILIPPINES: Luzon (1 specimen seen); Leyte (4). INDONESIA: Irian Jaya (1).

Notes: The Irian Jaya specimen only has partly peloric flowers, with rudiments of pollinia below the disfigured stelidia. The flowers are slightly larger, and have slightly narrower parts than the Philippine material, but are otherwise quite similar.

116. *Bulbophyllum disjunctum* Ames & C. Schweinf. — Fig. 6, plate 4.

Bulbophyllum disjunctum Ames & C. Schweinf., Orch. 6 (1920) 176; J.J. Verm., Orch. Borneo 2 (1991) 21 (pro parte, see also under *B. farinulentum* and its subspecies), **colour photograph 4a**. TYPE: Malaysia, Sabah, Gunung Kinabalu, Marei Parei Spur, *Clemens* 254 (AMES, holo.; BM, BO, K, NY, SING, iso.).

Rhizome 5—10 mm diam., sections between pseudobulbs 3.5—8 cm long. *Pseudobulbs* distant, ovoid, 1—2 x 0.8—1.5 cm. *Petiole* 6—16 cm. *Leaf blade* elliptic to obovate, 13—28 x 3—6.5 cm, index (length/width) 2.9—7.4; acute to acuminate. *Inflorescence* a lax raceme, erect to patent, 19—62 cm, 10—40-flowered. *Peduncle* 10—23 cm; bracts 5—8, the longest 28—42 mm long. *Rhachis* 9—39 cm. *Floral bracts* elliptic to ovate, 9—20 x 1.8—4 mm, acute. *Pedicel* and *ovary* 5—12 mm long. *Median sepal* ovate-triangular, 10.5—23 x 1.8—3.5 mm, index (3—)6.1—7.3; long-caudate, margins entire or slightly erose-papillose, base broadly attached; rather

Figure 5. *Bulbophyllum nemorale* L.O Williams (115) – a. Habit; b. inflorescence; c. Flower; d. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; e. Lip, above: adaxial side, below: abaxial side; f. Column and lip, lateral view; g. Anther, above: adaxial side, below: abaxial side; h. Pollinia, left: single pair, right: two pairs. – a, c, d. From *Wenzel 871*; b, h. From *Kalkman & Tissing 4187*; e—g. From *Wenzel 922* (all herbarium specimens).

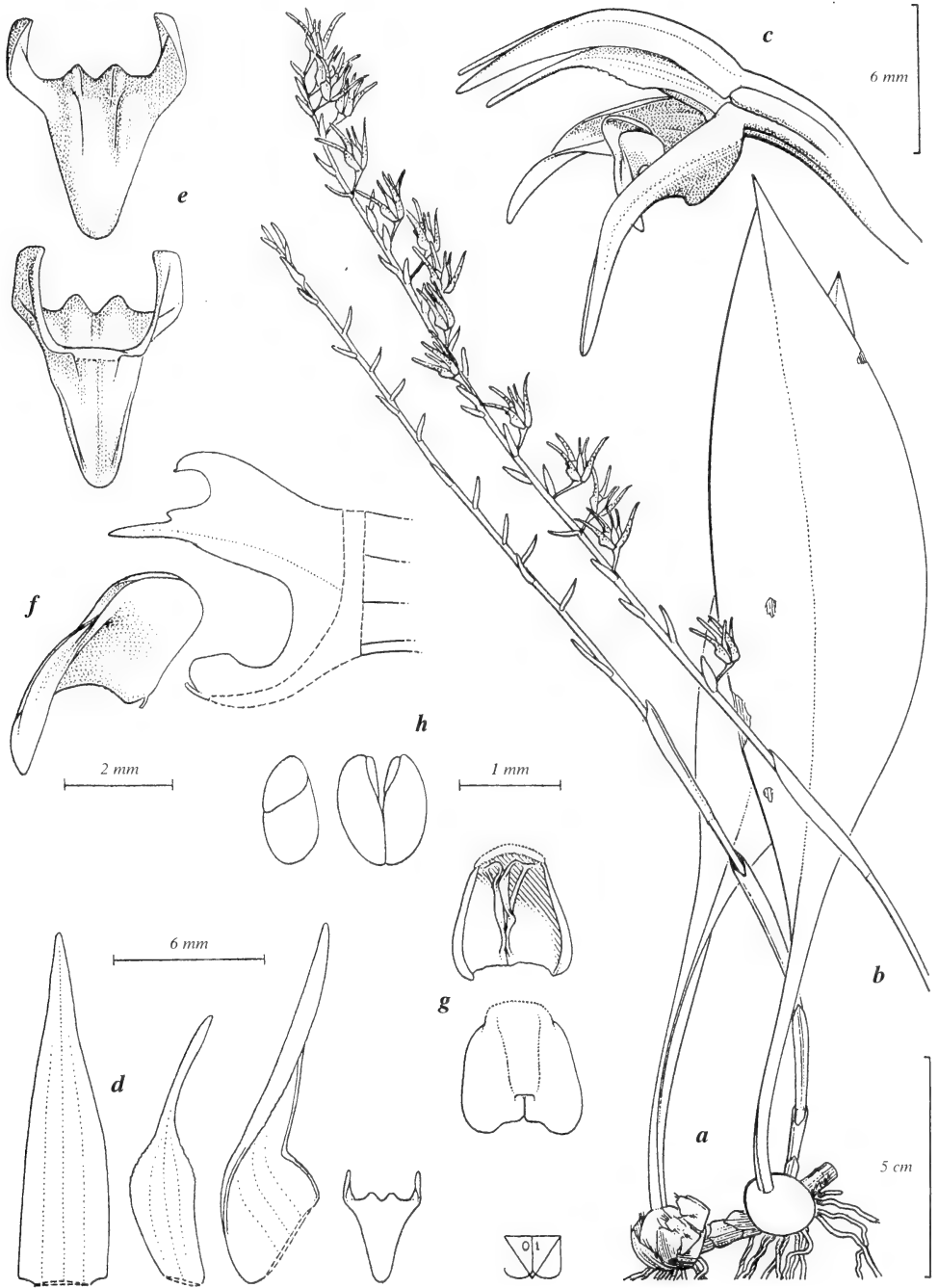


Figure 5. *Bulbophyllum nemorale* L.O Williams (115)

thin, surface glabrous, rarely slightly papillose adaxially. *Lateral sepals* (11.5—)16—32 x 2.5—4 mm, index (2.8—)6.4—8.3; otherwise as the median sepal. *Petals* recurved, tapering from a wide base, 7.5—16 x 1—2.5 mm, index (3—)7—9.4; acute, margins finely erose-denticulate, rarely almost entire, base rather broadly attached; thin, top somewhat thickened, surface glabrous, adaxially occasionally finely papillose towards the tip; with 1 vein. *Lip* recurved in the basal half, ovate to triangular, 3—6 x 1—2(—3) mm, index (1—)2—3; obtuse to acute, margins entire, finely papillose locally; rather thin; adaxially concave near the base, with 3 ridges: 2 distinct, obtuse to acute ridges proximally diverging and protruding like two erect to antrorse, conical, obtuse knobs and distally running parallel up 3/4 of the length of the lip or more, the space in between channelled and with a rather distinct, rounded median ridge with longitudinal rows of minute papillae proximally on its crest, adaxial surface otherwise glabrous or finely papillose locally; abaxially with rather inconspicuous, retuse to truncate ridge up to about 1/3 of the length of the lip, surface glabrous. *Column* 2.2—4 mm long. *Stelidia* ± subulate, 1—1.8 mm long, acute, with a small, antrorse, deltoid, obtuse to acute tooth along the upper margin; often with a rather inconspicuous, deltoid, obtuse to subacute wing along the lower margin, at the base.

Colours: Peduncle and floral bracts usually suffused with red, sometimes yellowish green. Pedicel and ovary pale green. Sepals and petals pale yellow or creamy white, usually with red dots partially aligned along the veins. Lip yellow with a paler base, with or without red markings. Flowers sweetly scented.

Habitat & ecology: Terrestrial or understorey epiphyte, often growing in moss, in montane forest. Also found in lowland *kerangas* forest. Alt. 500-3000 m. Flowering mainly in Mar, Apr, Oct—Dec, but incidental flowering recorded in most months.

Distribution: MALAYSIA: Sarawak (13 specimens seen); Sabah (22).

Notes: *Bulbophyllum farinulentum* differs from *B. disjunctum* in having rounded to obtuse leaf tips, adaxially papillose to pubescent sepals, papillose-ciliolate (rather than erose-denticulate) petals, and in lacking erect or antrorse knobs on the adaxial surface of the lip. The colours are also slightly different: *B. farinulentum* has sepals and petals with red veins, *B. disjunctum* has scattered red spots, more or less aligned along the veins.

Figure 6. *Bulbophyllum disjunctum* Ames & C. Schweinf. (116) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: abaxial side, right: adaxial side; e. Lip, left: adaxial side, right: lateral view; f. Column and lip, lateral view; g. Anther, above: abaxial side, below: adaxial side; h. Pollinia, left two pairs, right: single pair. – a. From Carr 3212; b—d, f—h. From De Vogel 8218; e. From Beaman 11128 (all herbarium specimens).

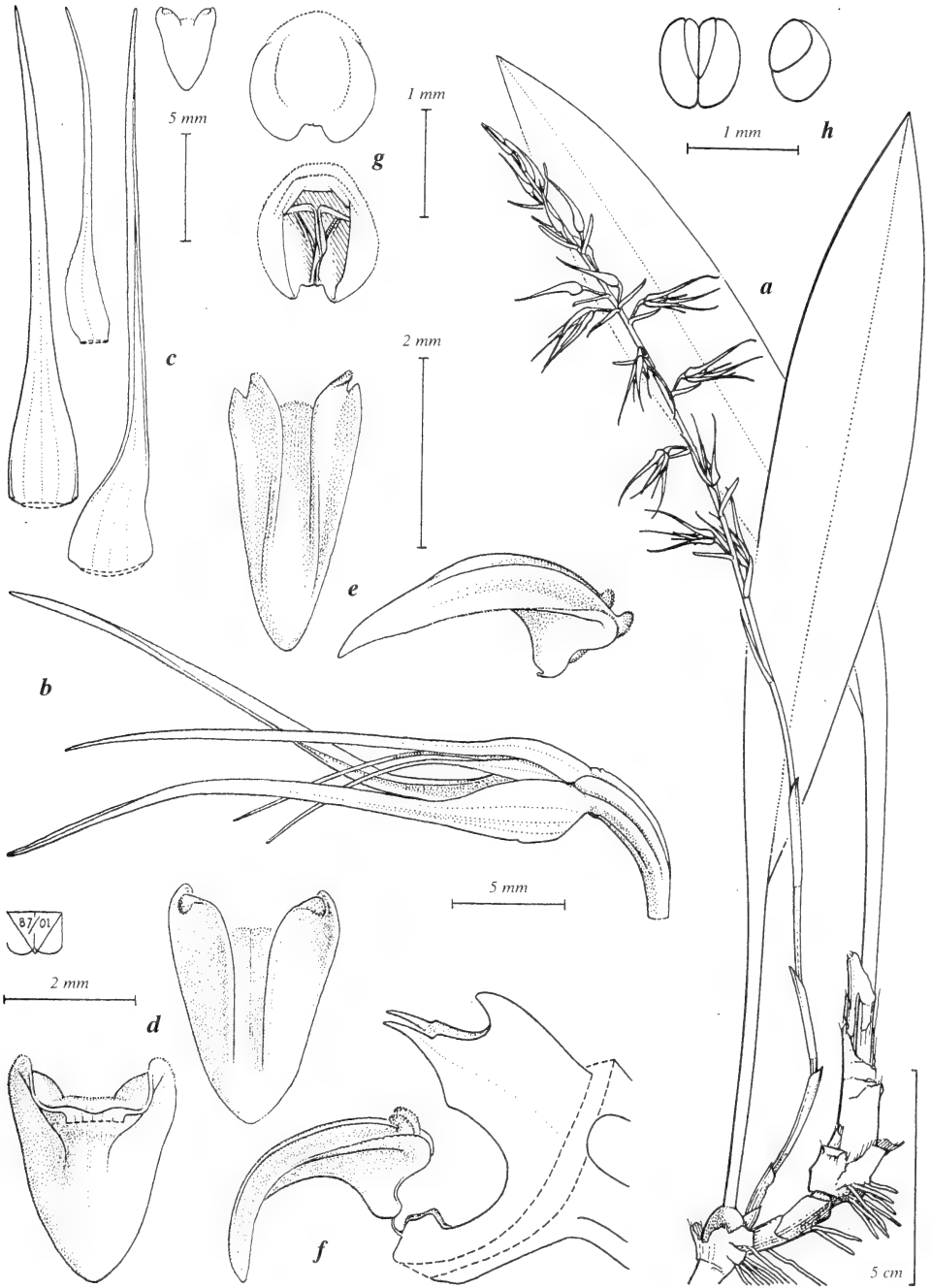


Figure 6. *Bulbophyllum disjunctum* Ames & C. Schweinf. (116)

Locally in Sarawak (*Hort. Leiden* 914075 & 980182, from the Hose Mts. and the Bario area respectively), a form with short, sturdy, rather dense inflorescences and relatively short and wide flower parts is found. The aberrant measurements are given between brackets in the description above. See plate 4, and compare with the normal form (Vermeulen 1991, colour photograph 4a; see above). The first specimen listed above also has the keels on the lip with inconspicuous knobs only. This form may be mistaken for *B. farinulentum* ssp. *densissimum*, but see below that subspecies.

117. *Bulbophyllum placochilum* J.J. Verm. — Fig. 7. (*probably extinct*)

Bulbophyllum placochilum J.J. Verm., *Orch. Borneo* 2 (1991) 29. — TYPE: Malaysia, Sabah, Gunung Kinabalu, *Clemens* 34056 (L, holo.; BM, NY, iso.).

Rhizome 5—10 mm diam., sections between pseudobulbs 4—11 cm long. *Pseudobulbs* distant, ovoid, 1—2 x 0.8—1 cm. *Petiole* 10—20 cm. *Leaf blade* elliptic, 23—38 x 4.5—11 cm, index (length/width) 3.2—5.1; acuminate. *Inflorescence* a dense raceme, erect to patent, 24—36 cm, 15—20-flowered. *Peduncle* 21—32 cm; bracts 7—9, the longest 30—42 mm long. *Rhachis* nodding near its base, slightly thickened, 3—4.5 cm. *Floral bracts* ovate, 8—10 x 2—3 mm, acute. *Pedicel* and *ovary* 6—10 mm long. *Median sepal* elliptic, 11—14 x 4—5.5 mm, index 2.5—2.6; rounded to obtuse, margins entire; glabrous, base broadly attached; rather thick. *Lateral sepals* slightly falcate, 10.5—14 x 4.5—4.8 mm, index 2.3—2.9; otherwise as the median sepal. *Petals* porrect, tapering from a wide base, 11—13 x 2—2.2 mm, index 5.5—5.9; obtuse, margins entire or minutely erose towards the tip; glabrous, base broadly attached; rather thin, somewhat thickened towards the tip; with 1 vein. *Lip* recurved near the base and reflexed near the tip, orbicular to transversely elliptic, 3—3.5 x 3.5—4 mm, index 0.7—1; acute, margins entire; glabrous, rather thin along the median line, thin elsewhere; adaxially slightly concave and with a central callus near the base, with 2 distinct, obtuse ridges without protruding knobs, diverging proximally and running from about 1/4 to 3/4 of the length of the lip, the space in between channelled; abaxially with a retuse ridge up to about 1/2 of the lip. *Column* 4.5—4.8 mm long. *Stelidia* somewhat falcate, triangular, 1.3—2 mm long, acute, with a broadly rounded wing along the lower margin, at the base.

Figure 7. *Bulbophyllum placochilum* J.J. Verm. (117) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Column and lip, lateral view; f. Anther, above: abaxial side, below: adaxial side. – All from *Clemens* 34065 (herbarium specimen).

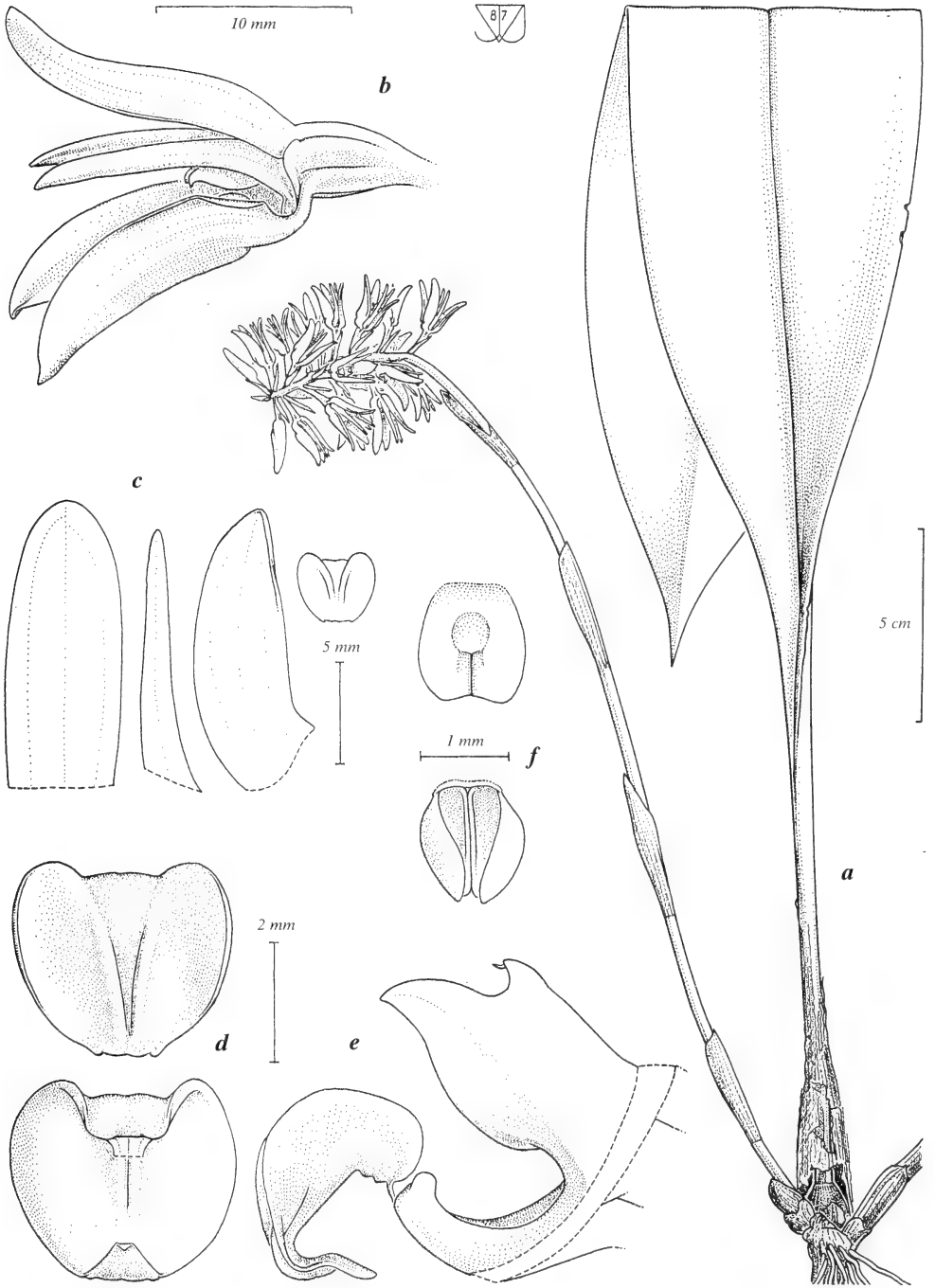


Figure 7. *Bulbophyllum placochilum* J.J. Verm. (117)

Colours: Flowers creamy yellow, sepals and petals minutely speckled pale purple in the top half; lip minutely speckled pale purple except for the top. Column white, front with two crimson streaks.

Habitat & ecology: Montane forest. Alt. 1500—1800 m. Flowering and fruiting in Jun—Aug.

Distribution: MALAYSIA: Sabah, Gunung Kinabalu only. (3 specimens seen). Not collected since 1933.

Notes. Without flowers, this could be mistaken for a small form of *B. elongatum*.

118. *Bulbophyllum elongatum* (Blume) Hassk. — Fig. 8.

Bulbophyllum elongatum (Blume) Hassk., Cat. Bogor. 2 (1844) 39. — *Ephippium elongatum* Blume, Bijdr. (1825) 309. — *Cirrhopetalum elongatum* (Blume) Lindl., Edward's Bot. Reg. 29 (1843) sub 49. — *Phyllorchis elongata* (Blume) Kuntze, Rev. Gen. Pl. 2 (1891) 677. — TYPE: Indonesia, Java, Gunung Salak, *Blume 195* (L, lecto.), 287 (L, syn.), s.n. *LHB 902,322-934* (L, syn.).

Bulbophyllum gigas Ridl., J. Linn. Soc., Bot. 32 (1896) 277. — TYPE: Malaysia, Perak, Maxwell's Hill, *Ridley (1893)* (SING, holo.).

Bulbophyllum sceptrum Rchb.f., Walp. Ann. 6 (1861) 254. — *Phyllorchis sceptrum* (Rchb.f.) Kuntze, Rev. Gen. Pl. 2 (1891) 678. — TYPE: Indonesia, 'Sundaic' Is. (W, holo., not seen).

[Not *B. elongatum sensu* F. Kraenzl., Bot. Jahrb. Syst. 34 (1905) 248; J.J. Sm., Repert. Spec. Nov. Regni Veg. 32 (1932) 310. — Specimen: *Beccari PS 10239* (FI, similar to the nominal taxon *B. korinchense* Ridl., sect. *Aphanobulbon*).]

Rhizome 5—13 mm diam., sections between pseudobulbs 3—17 cm long. **Pseudobulbs** distant, ovoid, 0.8—1.6 x 0.6—1.5 cm. **Petiole** 5.5—22 cm. **Leaf blade** elliptic, 20—50 x 6—16 cm, index (length/width) 3.1—3.9; acute to acuminate. **Inflorescence** a dense raceme, with the flowers in irregular whorls, erect to patent, 24—65 cm, 30—100-flowered. **Peduncle** 14—53 cm; bracts 7—8, the longest 25—80 mm long. **Rhachis** 3—12 cm, nodding near its base. **Floral bracts** ovate, 7—13 x 1.5—4 mm, acute. **Pedicel** and **ovary** 5—6 mm long. **Median sepal** elliptic, 12.5—17.5 x 3.8—4 mm, index 3.3—4.6; obtuse to acuminate, margins entire; glabrous, base rather narrowly attached; rather thin. **Lateral sepals** somewhat falcate, 12—16 x 3.5—4.5 mm, index 3.2—4; acute to acuminate, otherwise as the median sepal. **Petals** porrect, falcate, linear, tapering from a wide base, 10.5—15 x

Figure 8. *Bulbophyllum elongatum* (Blume) Hassk. (118) — a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Lip, adaxial side; f. Column and lip, lateral view; g. Anther, above: adaxial side, below: abaxial side; h. Pollinia, above: two pairs, below: single pair. — a—d, f—h. From *Hort. Leiden 26216* (spirit sample); e. From *Sands 5285* (herbarium specimen).



Figure 8. *Bulbophyllum elongatum* (Blume) Hassk. (118)

1.2—1.8 mm, index 7.2—10; obtuse to acute, margins entire; glabrous, base broadly attached; thin, top thickened; with 1 vein. *Lip* reflexed in the basal half, triangular with a projecting, linguiform top, 2.7—3.3 x 2.4—3 mm, index 1—1.2; rounded, margins entire; glabrous, rather thin, top thick; adaxially flat near the base, with 3 ridges without protruding knobs: 2 weak, rounded ridges, most conspicuous distally, the space in between channelled and with a inconspicuous, rounded median ridge with longitudinal rows of minute papillae on its crest proximally; abaxially with rather inconspicuous, truncate ridge up to about 1/2 of the length of the lip. *Column* 4.4—5 mm long. *Stelidia* narrowly triangular, 1.5—2.2 mm long, acute, with a small, antrorse, deltoid, obtuse to acute tooth along the upper margin; with an often inconspicuous, deltoid, obtuse tooth along the lower margin, at the base.

Colours: Sepals and petals white with purple spots. Lip yellow with fine red dots.

Habitat & ecology: Epiphyte in damp forest, near streams; also found as a terrestrial, creeping over the forest floor. Alt. 300—2000 m. Flowering in Jan—Mar, Aug—Dec.

Distribution: MALAYSIA: Peninsula (7 specimens seen); Sarawak (1); Sabah (1). BRUNEI (1). PHILIPPINES: Luzon (1); Negros (1); Leyte (2). INDONESIA: Sumatra (1); Java (4); Irian Jaya (1). PAPUA NEW GUINEA (2).

Notes: Plants from the Philippines are relatively small.

119. *Bulbophyllum lissoglossum* J.J. Verm. — Fig. 9.

Bulbophyllum lissoglossum J.J. Verm., Orch. Borneo 2 (1991) 25, **colour photograph pl. 4b**; J.J. Wood *et al.*, Plants of Mt. Kinabalu 2 (1993) 111, **colour photograph pl. 14b**. — TYPE: Malaysia, Sabah, Gunung Kinabalu, Vermeulen & Chan 390 (L, holo.; K, iso.).

Rhizome 4—6 mm diam., sections between pseudobulbs 1—3 cm long. *Pseudobulbs* close to distant, ovoid, 1.8—3 x 1—2.5 cm. *Petiole* 4—15 cm. *Leaf blade* elliptic, 15—27 x 2.1—4.5 cm, index (length/width) 3.8—8.5; acute to slightly acuminate. *Inflorescence* a rather dense raceme, erect to patent, 26—40 cm, 22—45-flowered. *Peduncle* 12—27 cm; bracts 6—7, the longest 18—32 mm long. *Rhachis* erect or arching, 8—16 cm. *Floral bracts* elliptic to ovate, 5.5—8 x 1.5—2 mm, acute. *Pedicel* and *ovary* 9—10

Figure 9. *Bulbophyllum lissoglossum* J.J. Verm. (119) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Column and lip, lateral view; f. Anther, above: adaxial side, below: abaxial side; g. Pollinia, left: two pairs, right: single pair. – All from Vermeulen & Chan 390 (living plant).

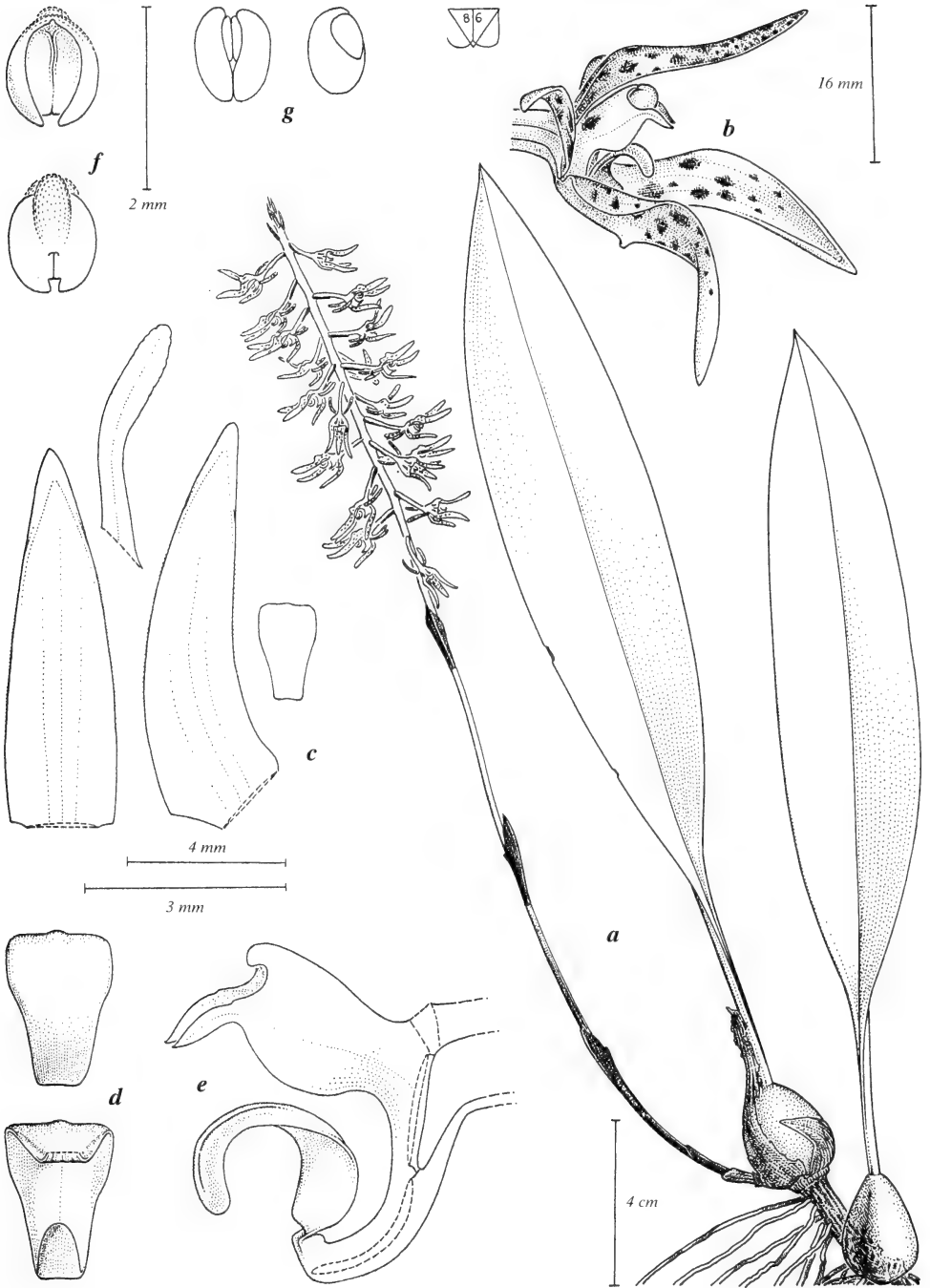


Figure 9. *Bulbophyllum lissoglossum* J.J. Verm. (119)

mm long. *Median sepal* ovate to triangular, 8—11.2 x 2—3 mm, index 3.2—4.5; subacute, margins entire, finely papillose locally, base rather broadly attached; rather thick, top thickened, surface glabrous. *Lateral sepals* somewhat falcate, 9—12 x 2—3 mm, index 3.3—4.5; otherwise as the median sepal. *Petals* porrect, falcate, linear, 5.5—6.5 x 0.8—1 mm, index 5.2—6.5; obtuse, margins slightly erose towards the tip; glabrous, base broadly attached; rather thin, thickened towards the tip; with 1 vein. *Lip* reflexed half-way, ± triangular, 2—3.5 x 1—1.8 mm (without spreading), index 1.5—2.4; obtuse, margins entire; glabrous; rather thick; adaxially without ridges, surface ± flat; abaxially with a weak, rounded ridge up to about 1/3 of the length of the lip. *Column* 2.5—3.5 mm long. *Stelidia* falcate linear, 1—1.5 mm long, acute, with a small, antrorse, deltoid, obtuse to acute tooth along the upper margin; with a broadly rounded wing along the lower margin, at the base.

Colours: Inflorescence purple or green, suffused with purple. Bracts pale green, spotted purple. Pedicel and ovary yellowish with some purple spots. Sepals white, slightly greenish at the base, the median spotted purple, the laterals only so in the basal half. Petals as the median sepal. Lip green, median part yellowish, top part suffused with purple but extreme tip bright green. Column white with a few purple spots. Flowers without smell.

Habitat & ecology: Understorey epiphyte, or terrestrial in moss cushions. Montane (*kerangas*) forest. Alt. 1000—1900 m. Flowering in May—Jul, Nov, Dec.

Distribution: MALAYSIA: Sabah, Gunung Kinabalu to Ulu Padas (8 specimens seen).

Notes: The Sarawak record in Vermeulen (1991: 25) is based on the erroneous identification of the specimen SAR (*Chai*) 33968, which is *B. disjunctum*.

Section *Hirtula* Ridl.

Bulbophyllum sect. *Hirtula* Ridl., Mat. Fl. Mal. Penins. 1 (1908) 68; J.J. Verm., Orch. Borneo 2 (1991) 231; Garay *et al.*, Nordic J. Bot. 14 (1994) 628. – LECTOTYPE (see Vermeulen, 1991: 231): *Bulbophyllum hirtulum* Ridl.

Bulbophyllum sect. *Barbula* J.J. Sm., Repert. Spec. Nov. Regni Veg. 32 (1932) 328. – TYPE: *Bulbophyllum trichoglottis* Ridl. (= *B. hirtulum* Ridl.).

Rhizome creeping. *Roots* predominantly sprouting below the pseudobulbs. *Pseudobulbs* 1-leafed, usually not or hardly laterally flattened, sometimes moderately flattened (*penicillium*, *ochthodes*), wrinkling with age in a random pattern. *Inflorescence* with many flowers, rarely 1-flowered (sometimes in *rariflorum*). *Rhachis* either not swollen when compared to

the peduncle, or swollen into a spindle-shaped, cylindrical, or bilaterally flattened body tapering towards both ends, with an inconspicuous to distinct depression below each flower. *Floral bracts* recurved to reflexed. *Flowers* usually spirally arranged (but [partly] distichous in *tremulum*, *xenosum* and *secundum*; partly in incomplete whorls in *polycyclum*), not resupinate, or resupinate (*secundum*), one to many open simultaneously. *Pedicel* and *ovary*: basal node either more or less flush with the surface of the rhachis, or on a stump up to 2 mm high. *Median sepal*: margins glabrous to distinctly ciliate; 1—3-veined. *Lateral sepals* free, margins glabrous to distinctly ciliate, the upper often with longer cilia than the lower; 1—5-veined. *Petals* \pm porrect, margins entire or slightly erose, sparsely (*cerebelum*) to distinctly ciliate, rarely papillose (*phreatiopse*); 1-veined. *Lip*: margins entire, usually with 1-celled cilia, hairs or spindle-shaped appendages, rarely sparsely ciliate (*cerebellum*, *limbatum*, *rariflorum*) or glabrous (*phreatiopse*); rather thin to thick, often fleshy, at the base usually with two small, sometimes inconspicuous (*lindleyanum*, *phreatiopse*, *parviflorum*), retrorse, semi-elliptic to triangular, obtuse auricles flanking the ligament. *Column*: stigma often protruding or with distinct teeth at its base, column foot sometimes somewhat thickened but otherwise without accessories. *Stelidia* often distinct, triangular to linear, often subulate, often with teeth along the upper and lower margins that may be so large that they together form an oblong structure from which only the tip of the stelidia protrude. *Anther* abaxially usually with a papillose to hairy ridge near its base; frontal part not or hardly projecting, front margin usually long ciliate, less often papillose, rarely \pm glabrous (*parviflorum*). *Pollinia* 4; the inner \pm half as long as the outer or longer, flattened on both sides; the outer flattened on one side. Stipes absent.

Distribution. China (3 species), Nepal (2), Bhutan (2), India (4 species, of which 1 is endemic), Myanmar (3), Thailand (8, 1 endemic), Vietnam (5, 2 endemic), Peninsular Malaysia (5, 2 endemic), Sumatra (7, 1 endemic), Java (1 endemic), Borneo (19, 14 endemic), Sulawesi (1 endemic), Philippines (4 endemic), New Guinea (1 endemic).

The use of the term 'lip margin'. Towards the tip of the lip, the margins may only be visible as a very thin flange or even a thin line, usually with hairs implanted. In several species with a very thick lip this line does not follow the full extension of the lip; but traverses the lip over the adaxial or abaxial surface. The opposite surfaces are then described as 'distinctly convex'. In several species a median ridge on the adaxial side overtops the distinctly convex adaxial surface.

Delimitation of the section. Sect. *Hirtula* includes a suite of species with usually rather 'hairy' flowers. The petals and/or the lip are indeed ciliate or otherwise set with 1-celled hairs in all species, although only

sparingly so in some. Moreover, a series of species (*B. eublepharum* Rchb.f., *B. insulsoides* Seidenf., *B. levinei* Schltr, and *B. scabratum* Rchb.f.), seemingly constitute a grading of the section into racemose species with a less 'hairy' aspect. An extended character set is necessary to delimitate sect. *Hirtula*:

- a. Pseudobulbs wrinkling in a random pattern with age. Occurs in all species of sect. *Hirtula*. It also occurs elsewhere, but not in the species listed above with *B. eublepharum*; these all have pseudobulbs wrinkling along pre-determined longitudinal lines.
- b. Inflorescence racemose. Occurs in all species of sect. *Hirtula*, although in *B. rariflorum* the inflorescence may abort after producing a single flower.
- c. Petals ciliate with 1-celled hairs. Occurs in all species, although *B. cerebellum* has only sparsely ciliate petals, and *B. phreatiopause* has papillose rather than ciliate petals. Elsewhere, ciliate petals are found in *B. eublepharum*, but this character is rarely found among SE Asian racemose *Bulbophyllum*. Species in and around sect. *Cirrhopetalum* all have fimbriate petals (with many-celled hairs).
- d. Lip with long hairs. Occurs in most species, although *B. cerebellum*, *B. hirtulum*, *B. limbatum*, and *B. rariflorum*, have only sparsely hairy lips, and *B. phreatiopause* has a glabrous lip. A long-haired lip is a rare character in other SE Asian racemose *Bulbophyllum* (present in, for instance, *B. refractum* Rchb.f. from Java).
- e. Two small auricles at the base of the lip, one on each side of the ligament connecting the lip to the column foot. These occur in all species, but are inconspicuous in *B. hirtulum*, *B. lindleyanum*, *B. phreatiopause*, and *B. parviflorum*. This character is unique within SE Asian racemose *Bulbophyllum*, although it occurs in some sections with 1-flowered species, for instance in a series of New Guinean species of sect. *Polyblepharon*.

If a polythetic set of a., b., and e. is chosen as diagnostic, this allows the exclusion of the species listed with *B. eublepharum* above, because these lack two out of the three characters.

Bulbophyllum phreatiopause displays two out of the three diagnostic characters, but its petals have papillose rather than ciliate margins, and the lip is glabrous. It does not fit well in sect. *Hirtula*, and has been included with doubt.

Bulbophyllum hastiferum Schltr, *B. pubiflorum* Schltr, *B. crassissimum* J.J. Sm., and *B. uvaeflorum* O'Byrne have shortly ciliate petals. Because the lateral sepals form a disc or spoon-shaped structure below the lip, these are better included in sect. *Osyricera*. O'Byrne originally included *Bulbophyllum uvaeflorum* in sect. *Hirtula*.

Several other similar-looking SE Asian species do not display the character set mentioned and are therefore excluded. *Bulbophyllum inconspicuum* Maxim. has fimbriate petals with many-celled hairs; *B. dayanum* Rchb.f. and similar species have ciliate petals, as well as two lateral lobes near the base of the lip. These lateral lobes, however, are attached in a much more distal position and are therefore not considered to be homologous with the auricles in sect. *Hirtula*.

Bulbophyllum vanum J.J. Verm. from Africa, as well as several Madagascar species included in the sections *Micromonanthe*, *Panthoblepharon*, and *Trichopus*, have ciliate petals, or a ciliate lip, or both. After analysing several species (*B. microglossum* Perr., *B. muscicolum* Schltr, *B. nigriflorum* Perr., and *B. pleurothallopsis* Schltr), I assume that none have auricles similar to the ones in sect. *Hirtula*.

Monophyly. The diagnostic set of characters is sufficiently sturdy to assume monophyly *a-priori*, possibly after exclusion of *Bulbophyllum phreatiopse*. For an outgroup, the first choice would be the series mentioned above with *B. eublepharum*.

Taxonomic views on sect. Hirtula. Ridley lists four taxa under his sect. *Hirtula*: *B. tenerum* Ridl. [a species close to *B. planibulbe* (Ridl.) Ridl.], *B. hirtulum* Ridl., *B. cincinnatum* Ridl. (is *B. hirtulum*), and *B. limbatum* Lindl. His section includes species with 'hairy' flowers (except for the probably erroneously included *B. tenerum*), with an elongated or subumbellate inflorescence. This general idea was retained in Vermeulen (1991). Garay *et al.* (1994: 628) state that only *Bulbophyllum carinilabium* and *B. hirtulum* (with some of its synonyms listed as separate taxa) can be included because of the chosen lectotype species of sect. *Hirtula*. They do not offer any further explanation, and I can only assume that the presence of a subumbellate inflorescence, present in both species, has been given priority over other characters in the delimitation of sect. *Hirtula*. The subumbellate *B. gemmareginae* and *B. cerebellum*, however, show that several flower morphologies found in the series with an elongated inflorescence are repeated in the series with a subumbellate inflorescence. I prefer a wider circumscription of sect. *Hirtula*, as proposed here, because it is more likely to result in a monophyletic group (see above).

Species delimitation. Many species of sect. *Hirtula* appear rare in existing collections; they are represented by only a few samples, or even by a single one. This puts a limit to the reliability of this revision, because a proper delimitation of the species was difficult and infraspecific variability could not be assessed with the material now available. So far, only *Bulbophyllum hirtulum* displays variability exceeding the average. Some species pairs have been found that could well be sister species: *B. lasioglossum*–*B. negrosianum*, and *B. jolandae*–*B. comberipictum*. The three

species *B. aithorhachis*–*B. sororculum*–*B. setuliferum* are rather similar and may be closely related. Their status may need revision once more material of all three becomes available, although the moderately rich material now available of *B. setuliferum* displays no signs of grading into any of the others. All taxa assumed to be part of a group of sister species have been given specific rank, *ad hoc* considerations as to the phylogeny of the group have not entered the taxonomy of the revision.

Cultivation. About 25 species have recently been in cultivation. Most are plants from the understorey of primary tropical forests, and have been grown successfully under conditions usually recommended for *Bulbophyllum*: a substratum that never dries out entirely, semi-shade, high air humidity and good air movement. A fair number of plants have been lost because of bacterial rot, turning the victims from green to brown within a few days. Proper ventilation or even a permanent, rather strong airflow over the plants seems to prevent this to a certain extent. It appears that several species found at medium altitudes do well in lowland conditions as long as shading and a continuous airflow keep the plants cool, although they are, of course, best grown at a temperature similar to that in their natural habitat. Species with long rhizomes, like *B. limbatum* and *B. rariflorum*, grow well on thin slabs of fern root, a tree fern trunk or an upright wooden support. Most other species prefer some soft organic matter among their roots, either planted on a slab or in a pot. Flowering is often irregular, and years may pass before plants decide that it is time to please their owner. On the whole, most species are interesting rather than spectacular, although *B. gemmareginae* and *B. xenosum* are striking plants with flowers of delicate colours and shapes.

Key to Species of *Bulbophyllum* sect. *Hirtula*

1. Inflorescence subumbellate (rhachis half as long as the width of the inflorescence, or shorter); *or* inflorescence with 1 flower, and pseudobulbs touching
 2. Lateral sepals reflexed; upper margin long ciliate 120. **B. gemma-reginae**
 2. Lateral sepals somewhat recurved; upper margin glabrous to finely papillose or ciliolate
 3. Lip distally with mobile c. 2 mm long, flat appendages along the margins 121. **B. carinilabium**
 3. Lip distally ciliate, without flat appendages
 4. Lateral sepals acute to acuminate. Lip without lateral lobes (next to inconspicuous basal auricles) 122. **B. hirtulum**

4. Lateral sepals rounded. Lip with lateral lobes attached along the proximal third of its length..... 123. **B. cerebellum**
1. Inflorescence an elongated raceme; *or* inflorescence with 1 flower, and at least some pseudobulbs widely distant
 5. Rhachis spindle shaped, or otherwise swollen when compared to the peduncle: (in some species difficult to see in herbarium material)
 6. Petal index (length /width) 0.6—1.6; petals reniform, (transversely) elliptic to ovate
 7. Lip ovate-subtriangular, distally rather thin and tapering towards a subacute tip
 8. Pseudobulbs discoid. Lip ovate in the proximal third, then abruptly narrowed and drawn out into a slender, tapering top part. Lip margins only with long, thin, wavy hairs 124. **B. clipeibulum**
 8. Pseudobulbs ovoid. Lip ovate-subtriangular, gradually tapering towards the tip. Lip margins with stiff hairs, some of these slightly swollen distally 125. **B. penicillium**
 7. Lip subspathulate, obovate, elliptic, or oblong, distally very thick and with a truncate to rounded tip (tip defined by the line along which the marginal hairs are inserted, excluding crests if present)
 9. Median ridge on the adaxial side of the lip protruding beyond the tip of the lip as a high crest
 10. Inflorescence ± erect, or with the peduncle patent, and the rhachis (slightly) nodding. Lip distally glabrous on the adaxial side (hairs implanted along the margins may cover adaxial surface)
 11. Rhachis, pedicel and ovary without blackish dots. Petal index (length/width) 0.6—0.7. Lip concave near the tip (a depression present on both sides of the median ridge) 126. **B. setuliferum**
 11. Rhachis, pedicel and ovary with minute blackish dots. Petal index 1.2—1.6. Lip not concave near the tip 127. **B. sororculum**
 10. Inflorescence entirely pendulous. Lip distally irregularly hirsute on the adaxial side 128. **B. aithorhachis**
 9. Median ridge on the adaxial side of the lip merging with the lateral ridges well before the tip of the lip, not protruding beyond the tip of the lip
 12. Pedicel and ovary with minute blackish dots. Rhachis c. 5 mm thick. Longest hairs on lip straight, slightly club-shaped 129. **B. echinochilum**

12. Pedicel and ovary without blackish dots. Rhachis c. 1.5 mm thick. Longest hairs on lip wavy, thin 130. **B. lanuginosum**
6. Petal index more than 1.6, or petals hastate
13. Lip abruptly narrowed at c. 1/3 of its length, then drawn out into a slender, tapering top part. Lip without a median ridge towards the tip 124. **B. clipeibulbum**
13. Lip rounded at the tip; or lip with a median ridge overtopping the rounded front
14. Column foot with an obtuse, papillose spur protruding from between the base of the lateral sepals 155. **B. debrincatae**
14. Column foot without a spur between the lateral sepals
15. Petal tips acute
16. Rhachis with the top 2—7 cm with only minute, sterile bracts and no flowers 131. **B. atratum**
16. Rhachis with flowers to the very tip
17. Whole inflorescence pendulous. Rhachis 2—3 mm thick 132. **B. groeneveldtii**
17. Peduncle erect or patent, rhachis nodding. Rhachis 6—7 mm thick 133. **B. grotianum**
15. Petal tips rounded to obtuse
18. Rhachis distinctly flattened, the top 3—3.5 cm with only minute, sterile bracts and no flowers
19. Sepals abaxially with scattered coarse papillae. Lateral sepals ovate, subacute. Lip adaxially finely hirsute 134. **B. janus**
19. Sepals abaxially glabrous. Lateral sepals triangular, acuminate. Lip adaxially glabrous except for the finely papillose top part 135. **B. xiphion**
18. Rhachis \pm circular in section, with flowers to the very tip
20. Flowers dimorphic: flowers along the basal part of the rhachis not much opening, with the lip 1.8—2.3 mm long; flowers along the top part opening wide, with the lip c. 4.2 mm long (flowers at the very tip of the rhachis smaller and with a smaller lip) 136. **B. mirabile**
20. Flowers all of \pm the same shape

- 21. Lip adaxially with a distinct, narrow median ridge embedded in a furrow over the distal 2/3 of the lip, and overtopping its tip as a high crest 127. **B. sororculum**
- 21. Lip adaxially flat or convex towards the tip, but without median ridge
 - 22. Lip adaxially papillose. Pseudobulbs distant 137. **B. spadiciflorum**
 - 22. Lip adaxially glabrous or irregularly wrinkled. Pseudobulbs touching
 - 23. Rhachis 1—1.8 cm long; flowers in a very dense raceme. Lip with lateral lobes attached along the proximal third of its length 123. **B. cerebellum**
 - 23. Rhachis 33—36 cm long, flowers in a rather lax raceme. Lip without lateral lobes (next to basal auricles flanking the ligament) 138. **B. polycyclum**
- 5. Rhachis about as thick as the peduncle
 - 24. Sepals adaxially partly or entirely pubescent or pilose
 - 25. Rhachis, pedicel, ovary, and abaxial surface of sepals densely hispid with short, stiff hairs 139. **B. lindleyanum**
 - 25. Rhachis, pedicel, ovary and abaxial surface of sepals glabrous
 - 26. Lip abaxially with numerous spindle-shaped hairs arising from tiny pits 140. **B. tremulum**
 - 26. Lip abaxially glabrous, pubescent or velutinous
 - 27. Lip pouch-shaped, deeply concave on the adaxial side 141. **B. scaphiforme**
 - 27. Lip only somewhat concave near the base on the adaxial side
 - 28. Lip 2.8—4.2 x 1—1.6 mm, abaxial surface convex towards the tip. Column 1—1.3 mm long 142. **B. nigripetalum**
 - 28. Lip 5—7 x 2—3.3 mm, abaxial surface ± flat to concave towards the tip. Column 1.4—1.8 mm long 143. **B. nigrescens**
 - 24. Sepals adaxially glabrous to finely papillose (margins often ciliate)
 - 29. Petal index (length/width) 3—4.6
 - 30. Lip 1.7—3 mm long (without stretching)
 - 31. Sepals abaxially hirsute. Lip adaxially with a circular depression near the tip 144. **B. trulliferum**
 - 31. Sepals abaxially glabrous. Lip adaxially convex near the tip

32. Rhizome sections between pseudobulbs 0.5—1.8 cm long 154. **B. secundum**
32. Rhizome sections between pseudobulbs 2—10 cm long 153. **B. parviflorum**
30. Lip 4—7.5 mm long
33. Anthesis starting at the base of the rhachis. Median sepal triangular, tapering towards the tip or caudate, margins glabrous or finely papillose
34. Pedicel and ovary 48—50 mm long. Median sepal c. 18.5 mm long. Lip margin with the longest hairs \pm straight 145. **B. jolandae**
34. Pedicel and ovary 8—20 mm long. Median sepal c. 7 mm long. Lip with the longest hairs distinctly wavy, woolly 146. **B. comberipictum**
33. Anthesis starting at the top of the rhachis. Median sepal elliptic, acute to shortly acuminate, margins ciliate
35. Lip adaxially with a median ridge continuing over c. 1/3 of the lip. Pedicel and ovary 7.5—14 mm long. Median sepal 6.5—9 mm long .. 147. **B. lasioglossum**
35. Lip adaxially with median ridge continuing over c. 3/4 of the lip. Pedicel and ovary 5.5—6.5 mm long. Median sepal 5.5—5.8 mm long 148. **B. negrosianum**
29. Petal index less than 3
36. Lip adaxially with 2—4 rows of distinct warts (calli) stretching over most of its length
37. Pseudobulbs touching. Lip with slightly club-shaped hairs. Stelidia with a strap-shaped to somewhat spatulate tooth with a 2—3-furcate tip along the lower margin, near the base 149. **B. dracunculus**
37. Pseudobulbs distant. Lip without club-shaped hairs. Stelidia with a deltoid to triangular, obtuse or acute tooth along the lower margin, near the tip
38. Lip 6—6.8 mm long, adaxially with 4 rows of irregularly shaped calli 150. **B. polygaliflorum**
38. Lip c. 3.1 mm long, adaxially with 2 rows of irregularly shaped calli 151. **B. ochthodes**
36. Lip adaxially without calli, or with a single callus near its base

- 39. Lip adaxially near the base with a triangular callus
 - 40. Rhizome sections between pseudobulbs 4—19 cm long. Margins of lip glabrous.... 152. **B. phreatiopse**
 - 40. Rhizome sections between pseudobulbs 0.5—1.8 cm long. Margins of lip ciliate 154. **B. secundum**
- 39. Lip adaxially near the base without a callus
 - 41. Lip 1.7—3 mm long (without stretching)
 - 42. Rhizome sections between pseudobulbs 2—10 cm long 153. **B. parviflorum**
 - 42. Rhizome sections between pseudobulbs 0.5—1.8 cm long 154. **B. secundum**
 - 41. Lip 3.5—7.5 mm long
 - 43. Lip margins with long hairs
 - 44. Lip margins glabrous half-way. Petals triangular-ovate 155. **B. deprincatiæ**
 - 44. Lip margins with hairs from base to tip. Petals obovate
 - 45. Median sepal index (length/width) 2.3—2.4, margins with long hairs 156. **B. pilosum**
 - 45. Median sepal index 7—8, margins ciliate 157. **B. xenosum**
 - 43. Lip margins papillose-ciliolate
 - 46. Floral bracts triangular, not clasping the rhachis. Inflorescence with many flowers open simultaneously 158. **B. limbatum**
 - 46. Floral bracts tubular, clasping the rhachis. Inflorescence with a single flower open only; each flower developing only after anthesis of the previous one 159. **B. rariflorum**

120. *Bulbophyllum gemma-reginae* J.J. Verm. – Fig. 10, plate 5.

Bulbophyllum gemma-reginae J.J. Verm., Blumea 41 (1996) 21. — TYPE: Malaysia, Sabah, Ulu Padas, *Jongejan cult. 1856* (L, holo.).

Rhizome c. 1.3 mm diam., sections between pseudobulbs 0.2–0.7 cm long. *Pseudobulbs* touching, ovoid to ± globose, 0.5–1.2 x 0.3–0.7 cm. *Petiole* 0.3–0.4 cm. *Leaf blade* elliptic, 5–6.7 x 1.5–3.3 cm, index (length/width) 1.9–4.1; subacute. *Inflorescence* a subumbellate raceme, patent to ± pendulous, c. 3 cm, 7–10-flowered. *Peduncle* c. 2.7 cm; bracts c. 6, the longest c. 3 mm long. *Rhachis* porrect or arching, spindle-shaped, c. 0.3 x 0.12 cm. *Floral bracts* triangular, 0.8–1.2 x 0.6–0.8 mm, acute to shortly acuminate. *Flowers* opening wide, many simultaneously. *Pedicel* and *ovary* 7.5–10 mm long, basal node on a c. 0.5 mm-long stump. *Median sepal* reflexed, triangular, c. 5.8 x 1.9 mm, index c. 3; acute, margins long ciliate, base broadly attached; thin, surface glabrous. *Lateral sepals* ovate, c. 6.3 x 2.7 mm, index c. 2.3; subacute, otherwise as the median sepal. *Petals* porrect, ovate, c. 4.3 x 1.2 mm, index c. 3.6; acuminate, margins ciliate, base rather broadly attached; thin, surface shortly pubescent towards the tip. *Lip* abruptly recurved near the base, spatulate, c. 5 x 1.4 mm, index c. 3.6; rounded, margins ciliate with the cilia longest c. half-way up the lip; thick, surface ± glabrous; adaxially slightly concave and with two calli near the base, with a median slit up to c. 1/3 of the lip, with two distinct, obtuse ridges proximally diverging and distally continuing parallel and close together over 2/3–3/4 of the lip, with the distal half slightly concave; abaxially with a distinct, rounded ridge near the base, elsewhere ± flat. *Column* c. 1.1 mm long, stigma protruding at its base, column foot with two longitudinal, deltoid, rounded lamellae. *Stelidia* falcate, c. 0.8 mm long, acute, ± rectangular in outline with a large, antrorse, triangular, acute tooth along both margins. *Anther*: front margin ciliate, abaxial ridge ± glabrous.

Colours: Sepals creamy yellow, suffused with pale reddish brown towards the tip. Petals creamy yellow, with almost black lines bordering the midvein and the margins. Lip white, ridges on adaxial side greyish with minute white specks, top part with greyish black margins, hairs yellowish. Column yellow, foot with reddish purple spots.

Habitat & ecology: Understorey epiphyte in lower montane forest. Alt. c. 1100 m.

Figure 10. *Bulbophyllum gemma-reginae* J.J. Verm. (120) – a. Habit; b. Flower, including rhachis; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Column and lip, lateral view; f. Anther, above: abaxial side, below: adaxial side; g. Pollinia, left: single pair, right: two pairs. — All from *Jongejan cult. 1856* (spirit sample).

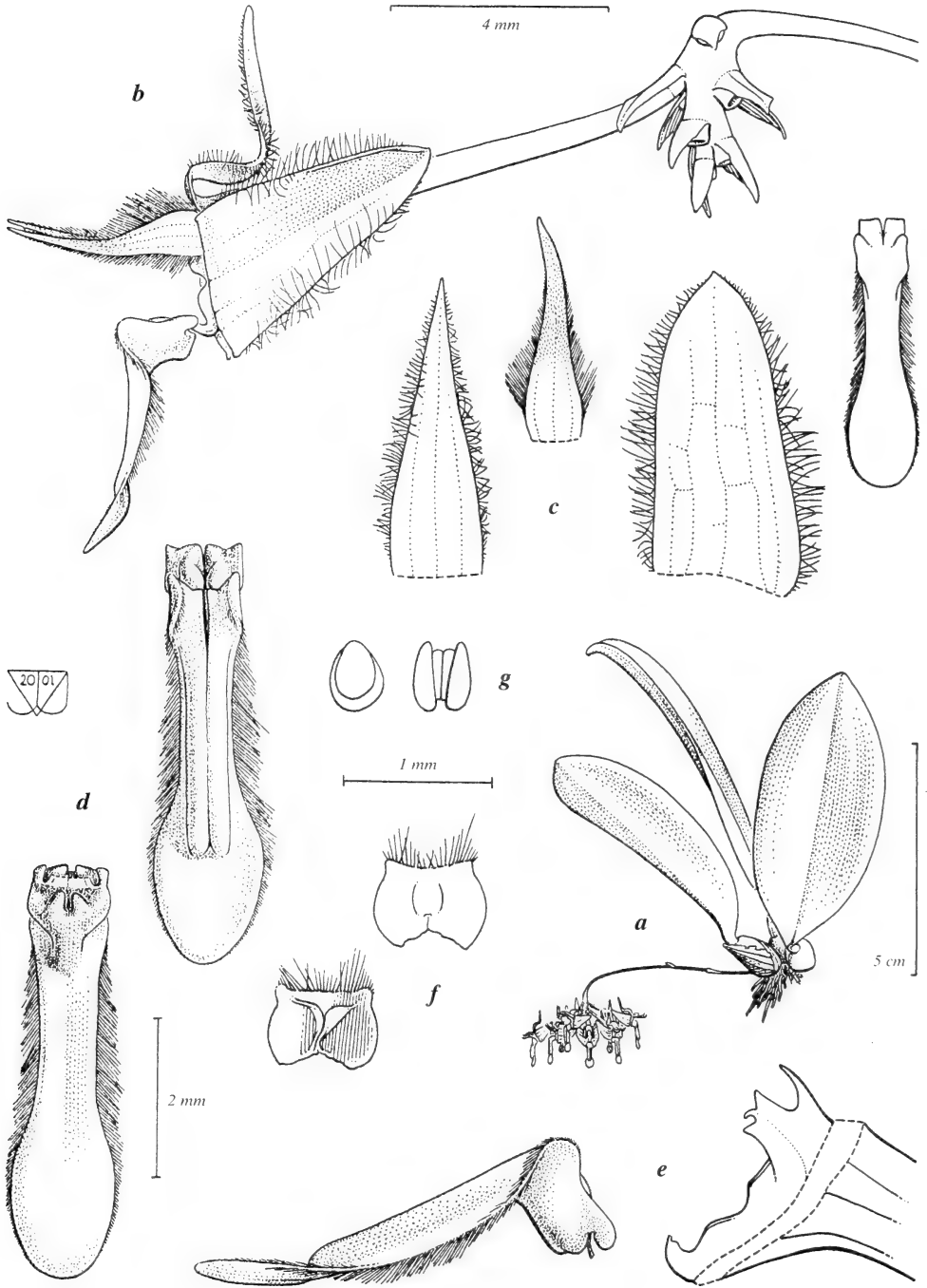


Figure 10. *Bulbophyllum gemma-reginae* J.J. Verm. (120)

Distribution: MALAYSIA: Sabah, Ulu Padas (1 specimen seen).

121. *Bulbophyllum carinilabium* J.J. Verm. – Fig. 11, plate 6.

Bulbophyllum carinilabium J.J. Verm., Orch. Borneo 2 (1991) 233. — TYPE: Malaysia, Sabah, Ulu Padas, *Vermeulen 641a* (L, holo.; K, iso.).

Rhizome 2.5–4 mm diam., sections between pseudobulbs 0.4–1 cm long. *Pseudobulbs* (almost) touching, ovoid to \pm globose, 0.8–1.8 x 0.5–1.2 cm. *Petiole* 0.3–2.3 cm. *Leaf blade* elliptic to ovate, 5.5–15 x 2.5–5 cm, index (length/width) 2–5.4; acute. *Inflorescence* a subumbellate raceme, 4–16.4 cm, 4–11-flowered. *Peduncle* patent to \pm pendulous, 3.7–15.7 cm, bracts 3, the longest 3.5–6 mm long. *Rhachis* porrect or arching, spindle-shaped, 0.3–0.7 x 0.1–0.18 cm. *Floral bracts* triangular, 1–1.3 x 0.6–0.8 mm, subacute. *Flowers* not much opening, few to many simultaneously. *Pedicel* and *ovary* 3.5–5 mm long, basal node almost flush with the surface of the rhachis. *Median sepal* porrect, ovate, 7–9 x 1.5–2.8 mm, index 2.8–6; (sub)acute, margins ciliate, base rather broadly attached; thin, surface glabrous. *Lateral sepals* somewhat recurved, 7–10 x 2–3 mm, index 2.3–5; obtuse to acute, margins glabrous; rather thin, otherwise as the median sepal. *Petals* porrect, triangular, 2–2.2 x 1–1.3 mm, index 1.6–2; (sub)acute, margins ciliate, base broadly attached; thin, surface glabrous. *Lip* \pm straight but with a deep transverse fold near the base, elliptic to ovate with a narrow claw, 4.8–5.7 x 1.5–2.8 mm, index 1.9–3.8; rounded to obtuse, margins ciliate but with mobile, c. 2 mm long, linear, flat appendages near the tip; thick; adaxially concave near the base, with a narrow median ridge in the proximal 1/3, with two distinct calli clasping its distal end, with the distal 2/3 flat or slightly concave but with a small callus near the tip, with the surface glabrous except for a scabrous median strip over the distal 2/3; abaxially with a weak, rounded ridge over the distal three-quarters, surface glabrous. *Column* 1.6–2 mm long, column foot with two longitudinal, subtriangular lamellae clasping the median ridge on the adaxial side of the lip. *Stelidia* semi-elliptic, 0.7–1 mm long, rounded. *Anther*: front margin densely papillose with elongate papillae, abaxial ridge \pm glabrous.

Colours: Sepals purple, base whitish or yellow with purple veins. Petals purple. Lip dark purple, sometimes yellowish green towards the base; the cilia white, the appendages near the tip purple or yellowish with

Figure 11. *Bulbophyllum carinilabium* J.J. Verm. (121) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, left: abaxial side, right: adaxial side; g. Pollinia, above: two pairs, below: single pair. – All from *Vermeulen 641a* (living plant).

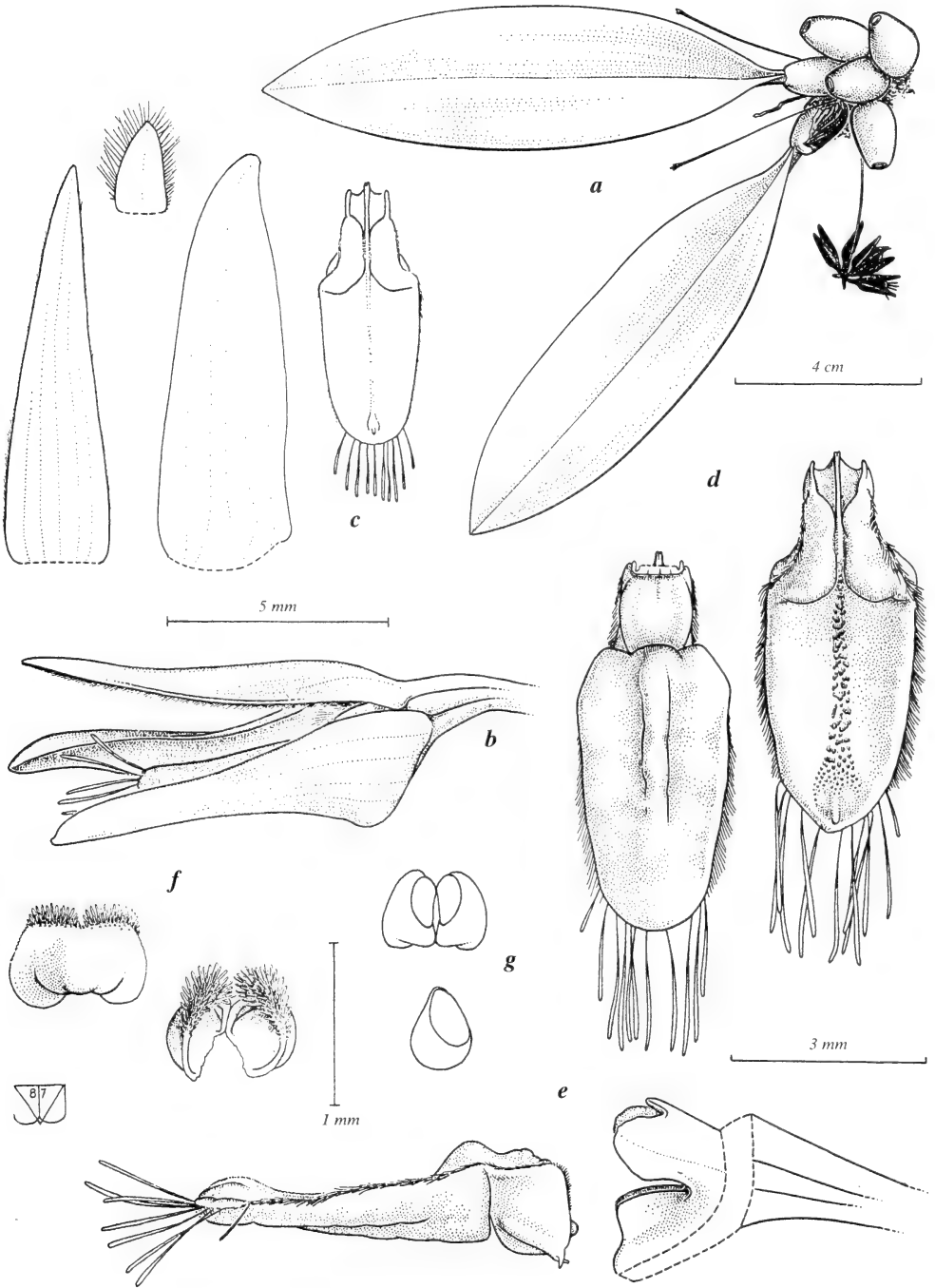


Figure 11. *Bulbophyllum carinilabium* J.J. Verm. (121)

purple margins.

Habitat & ecology: Understorey epiphyte in montane forest. Alt. 1500—3600 m. Flowering in Mar—May, Oct.

Distribution: MALAYSIA: Sabah, Gunung Kinabalu to Ulu Padas (5 specimens seen).

122. *Bulbophyllum hirtulum* Ridl. – Fig. 12.

Bulbophyllum hirtulum Ridl., J. Bot. 38 (1900) 71, J.J. Verm., Orch. Borneo 2 (1991) 237, **colour photograph pl. 16e**. — TYPE: Malaysia, Penang Hill, *Ridley & Curtis s.n.* (K holo.).

Bulbophyllum cincinnatum Ridl., J. Straits Branch Roy. Asiat. Soc. 39 (1903) 75. — TYPE: Malaysia, Perak, Batu Tujoh, *Ahmad s.n.* (K, holo.).

Bulbophyllum trichoglottis Ridl., J. Fed. Malay States Mus. 4 (1909) 66. — TYPE: Malaysia, Pahang, Telom, *Hort. Singapore (Ridley) 1909* (SING, holo.).

Bulbophyllum trichoglottis Ridl. var. *sumatranum* J.J. Sm., Bull. Jard. Bot. Buitenzorg, s. 3, 2 (1920) 98. — TYPE: Indonesia, Sumatra, Barisan Range, *Ajoeb (Exp. Jacobson) 807* (BO, holo.; K, L, SING, iso.).

Bulbophyllum salaccense sensu Beaman, T.E., *et al.*, Orch. Sarawak (2001) **colour photograph pl. 7c**, non Rchb.f.

Rhizome 1.2—2.5 mm diam., sections between pseudobulbs 0.15—0.7 cm long. *Pseudobulbs* touching, ovoid to \pm globose, 0.2—1 x 0.2—0.7 cm. *Petiole* 0.3—2.2 cm. *Leaf blade* elliptic to obovate, 2.2—17 x 0.7—6 cm, index (length/width) 2—3.5; obtuse to acute. *Inflorescence* hidden below the leaves, a subumbellate raceme, 4.5—10 cm, (1—)2—14-flowered. *Peduncle* patent to \pm pendulous, 4.3—9.5 cm, bracts 4—5, the longest 3—7 mm long. *Rhachis* porrect or arching, spindle-shaped, 0.3—0.7 x 0.1—0.18 cm. *Floral bracts* triangular, 1—1.3 x 0.6—0.8 mm, subacute. *Flowers* not much opening, many simultaneously. *Pedicel* and *ovary* 2—4 mm long, basal node on a 0.2—0.5 mm-long stump. *Median sepal* porrect, sometimes reflexed, ovate to triangular, 4.5—6.5 x 1.8—3.3 mm, index 1.4—2.5; acute to acuminate, margins finely papillose to ciliolate; base broadly attached; rather thin, adaxial surface glabrous, abaxial surface glabrous or finely papillose. *Lateral sepals* somewhat recurved, 4—6 x 2.5—5 mm, index 1.1—2.2; otherwise as the median sepal. *Petals* porrect, ovate, 2—4 x 0.7—2 mm, index 2.1—3.6; obtuse to acute, margins ciliate, base broadly attached; thin, surface glabrous or adaxially slightly papillose towards the tip. *Lip*

Figure 12. *Bulbophyllum hirtulum* Ridl. (122) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Column and lip, lateral view; f, g, h. Lip, adaxial side; i, j, k. Column, lateral view; l. Anther, left: adaxial side, right: abaxial side; m. Pollinia, left: single pair, right: two pairs. – a—e, l, m. From *TOC cult. 1203* (living plant); f, i. From *Carr s.n.*; g, j. From *Chan s.n.*; h, k. From *Lewis 291* (all spirit samples).

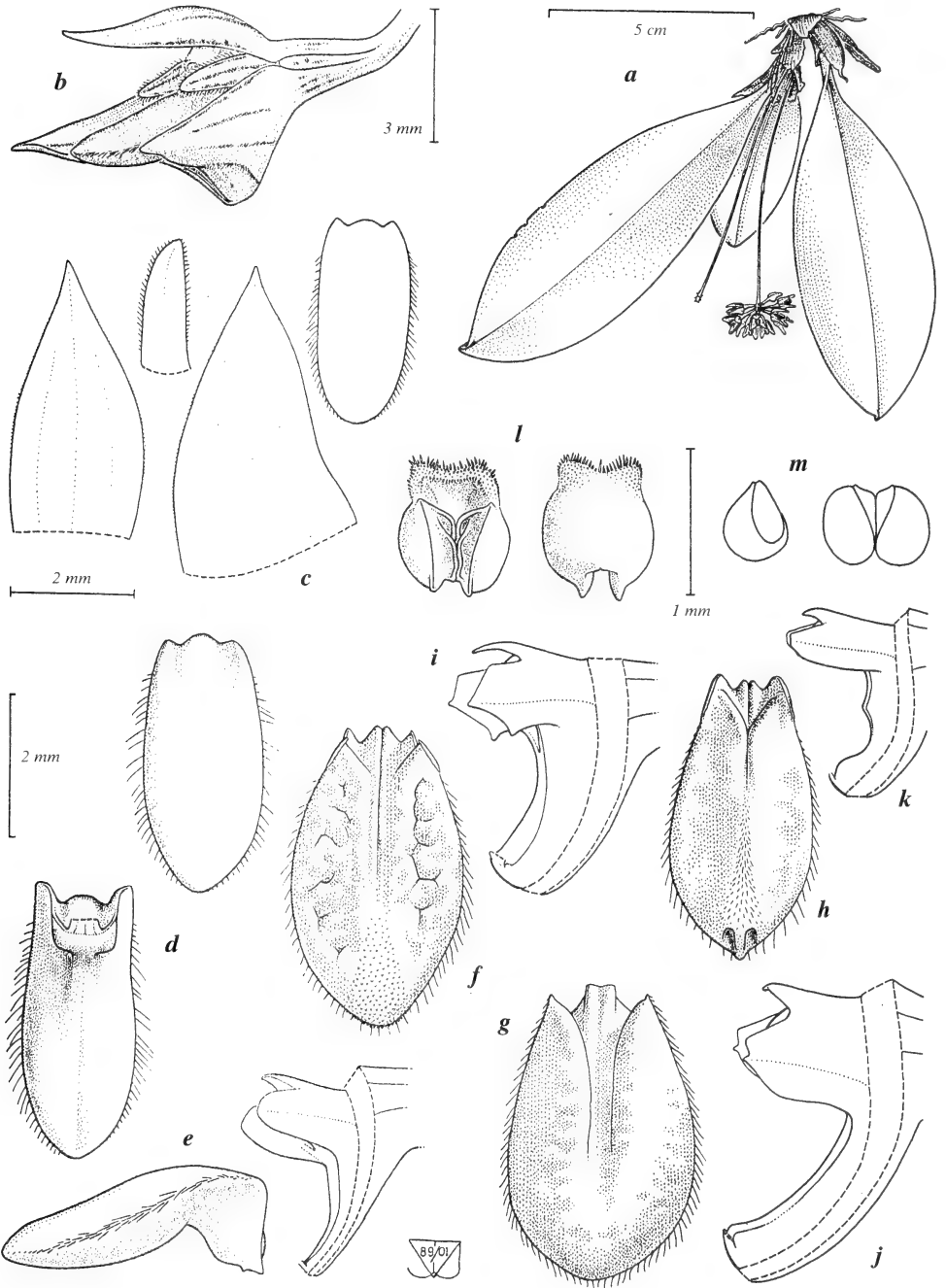


Figure 12. *Bulbophyllum hirtulum* Ridl. (122)

without lateral lobes, abruptly recurved in the proximal half or half-way, elliptic to obovate, 2.6—4 x 1.5—2.8 mm, index 1.3—2.6; rounded, sometimes apiculate, margins ciliate; thick; adaxially (slightly) concave and with 1—2 calli near the base, with or without a median slit up to c. 1/2 of the lip, with two inconspicuous to distinct, proximally diverging, obtuse ridges, with the surface distally convex, with or without two tiny pits close to the tip, with the surface smooth to coarsely, often transversely wrinkled, often finely papillose all over or with a patch of hairs or papillae distally along the median line; abaxially with a retuse to rounded ridge near the base, surface distally convex, smooth to coarsely wrinkled; basal auricles inconspicuous. *Column* 1.2—2.2 mm long, column foot often with two weak, longitudinal ridges. *Stelidia* semi-elliptic or triangular, 0.6—0.9 mm long, rounded to acute, if triangular with a patent to antrorse, semi-circular to triangular, rounded to acute tooth along the upper margin, and with a similar tooth along the lower margin, sometimes with a second, retrorse tooth along the lower margin. *Anther*: front margin densely ciliate or papillose with elongated papillae, abaxial ridge \pm glabrous.

Colours: Sepals whitish, creamy yellow, or yellowish green; margins, veins and sometimes transverse veins reddish purple. Petals the same, but without coloured transverse veins. Lip dark red purple, white near the base, and adaxially with a white, cream, or pink strip along the midvein. Flowers sometimes faintly scented.

Habitat & ecology: Understorey epiphyte in mixed dipterocarp forest and *kerangas* forest. Alt. 200—1400 m. Flowering in Jan—Mar, Jul, Sep, Oct.

Distribution: MALAYSIA: Peninsula (7 specimens seen); Sarawak (5); Sabah (3). INDONESIA: Sumatra (2); Kalimantan (1).

Notes: *Bulbophyllum hirtulum* shows infraspecific variability in the following characters:

- The median sepal may be reflexed instead of porrect (Sarawak).
- The lip may have a patch of hairs distally on the adaxial side of the lip (Sarawak).
- The lip may have two tiny pits near the tip, on the adaxial side (Sarawak, Peninsular Malaysia). The wall separating the pits may develop into a triangular, acute tooth forming a hood over the pits (Peninsular Malaysia).
- The stelidia may have a triangular, subacute tooth along their lower margin (Peninsular Malaysia, Sarawak, and Sumatra).
- The median slit on the adaxial side of the lip may extend over c. 1/5 of the length of the lip or more.
- The upper and the lower surface of the lip are entirely smooth, without corrugations (Sabah).

All these characters occur single, or in any number, and in various

combinations. Therefore, they cannot be used to distinguish infraspecific taxa.

123. *Bulbophyllum cerebellum* J.J. Verm. – Fig. 13, plate 7.

Bulbophyllum cerebellum J.J. Verm., *Blumea* 41 (1996) 350. – TYPE: ‘Borneo’ no further details known, *Giles 998* (K, holo.).

Rhizome 2–2.5 mm diam., sections between pseudobulbs 0.4–1.3 cm long. *Pseudobulbs* touching, ovoid, 1.2–2.5 x 0.7–1.2 cm. *Petiole* 1.5–2.5 cm. *Leaf blade* elliptic to (ob)ovate, 5–14 x 1.5–3.5 cm, index (length/width) 3.3–4; acute. *Inflorescence* a very short and dense or a subumbellate raceme, 4–12 cm, 10–29-flowered. *Peduncle* patent to pendulous, 3.8–10 cm, bracts c. 5, the longest 3–6 mm long. *Rhachis* pendulous, spindle-shaped, 1–1.8 x c. 0.3 cm, glabrous. *Floral bracts* triangular, 1–1.5 x 0.8–1 mm, acute. *Flowers* not much opening, many simultaneously. *Pedicel* and *ovary* 2.6–3.5 mm long, basal node on a 0.2–0.3 mm-long stump. *Median sepal* ± porrect, triangular, 3.6–4.6 x 2–3 mm, index 1.2–1.9; acute, margins with scattered very fine papillae, base rather broadly attached; rather thin, surface glabrous. *Lateral sepals* somewhat recurved, 4–5.5 x 3.2–4.3 mm, index 1.2–1.3; rounded, upper margin glabrous, lower ciliolate, base broadly attached; otherwise as the median sepal. *Petals* porrect, ovate, 2.8–3.2 x 1.5–1.9 mm, index 1.5–1.9; rounded, margins sparsely and very finely ciliate, base rather narrowly attached; rather thin, surface glabrous. *Lip* abruptly recurved c. half-way, 3-lobed; *midlobe* ± elliptic, 2.6–3.4 x 1.4–3 mm, index 1.4–1.9; rounded, margins shortly and sparsely ciliate towards the tip; very thick, surface irregularly wrinkled except for the glabrous basal part; adaxially concave and with a short median slit near the base, with two distinct erect ridges diverging proximally, continuing over c. 1/3 of the lip and distally truncate, surface distally distinctly convex; abaxially with a wide, rounded ridge towards the base, distinctly convex towards the tip; *lateral lobes* attached along the proximal 1/3 of the lip, antrorse, falcate, ovate, rounded, entire, glabrous, broadly attached, rather thin. *Column* 1–1.5 mm long, column foot somewhat swollen, abaxially without a spur near the tip. *Stelidia* 0.7–1 mm long, acute, ± rectangular in outline, with or without a distinct, antrorse, deltoid, obtuse tooth along the upper margin and with a similar, obtuse to acute tooth along the lower margin. *Anther*: front margin papillose with elongated papillae, abaxial ridge ± glabrous.

Colours: Peduncle purplish or dark red, rhachis green. Pedicel and ovary yellowish green. Sepals yellow or yellowish green, with some brownish stains towards the tip or with brown veins. Petals yellow, with pale purple or brownish spots towards the tip. Lip bright yellow, base and lateral lobes

pale greenish, sometimes with brownish stains. Column yellow.

Habitat & ecology: Epiphyte in primary forest. Alt. c. 1300 m. Flowering in May, Oct.

Distribution: MALAYSIA: Sabah (3 specimens seen).

124. *Bulbophyllum clipeibulbum* J.J. Verm. – Fig. 14, plate 8.

Bulbophyllum clipeibulbum J.J. Verm., Malayan Orch. Rev. 35 (2001) 51. — TYPE: no locality, Hort. Salzburg OR 637/94 (SZU, holo.; SING, iso.).

Rhizome 5–6 mm diam., sections between pseudobulbs 3.5–4.5 cm long. *Pseudobulbs* touching, dorsiventrally discoid, 1.0–1.8 x 3.5–5.5 cm. *Petiole* 38–60 cm. *Leaf blade* elliptic-ovate, 14.5–22 x 4–6 cm, index (length/width) 2.8–4.4; acute. *Inflorescence* an elongated, lax raceme, c. 50-flowered. *Rhachis* arching or nodding, spindle-shaped, c. 19 x 0.7 cm (at an early stage of anthesis), slightly and finely rugose-verruculate. *Floral bracts* ovate to triangular, 4.5–5 x c. 1.5 mm, acute. *Flowers* not fully opening, several simultaneously. *Pedicel* and *ovary* c. 3.6 mm long, basal node on a 0.2–0.4 mm-long stump. *Median sepal* recurved at the tip, ovate-triangular, c. 9.8 x 2 mm, index c. 4.9; acuminate, margins very finely ciliate, base narrowly attached; rather thick, surface adaxially glabrous, abaxially very finely papillose. *Lateral sepals* triangular, c. 10.2 x 3 mm, index 3.4; upper margin glabrous but shortly papillose locally, base broadly attached; otherwise as the median sepal. *Petals* porrect, ovate, c. 1.5 x 0.9 mm, index 1.6–1.7; subacute, margins erose, long ciliate, base broadly attached; rather thin, surface glabrous but with a few hairs distally on both sides. *Lip* recurved and ovate in the proximal third, distally abruptly narrowed and drawn out into a slender, gradually tapering top part; c. 6.3 x 1.2 mm, index 5.2–5.3; tip subacute, margins ciliate near the base, elsewhere with long, thin, wavy hairs; lip rather thick in the proximal third, rather thin elsewhere; adaxially concave near the base, with two rounded ridges separated by a median furrow c. half-way up the proximal third, adaxial surface glabrous but very finely papillose at about 1/3 of its length; abaxially with a wide, rounded ridge towards the base, slightly convex elsewhere, surface glabrous but with a tuft of long, thin wavy hairs at about 1/3 of its length. *Column* c. 2.2 mm long, stigma protruding at its base. *Stelidia* subulate with a knob-shaped, rounded tip, c. 1.5 mm long; with an inconspicuous, rounded wing along the lower margin, at the base. *Anther*:

Figure 13. *Bulbophyllum cerebellum* J.J. Verm. (123) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Column and lip, lateral view; f. Anther, left: abaxial side, right: adaxial side; g. Pollinia, left: two pairs, right: single pair. – a. From a photograph by A. Kocyan; b. From Kocyan s.n. (spirit sample); c–g. From Giles 998 (spirit sample).

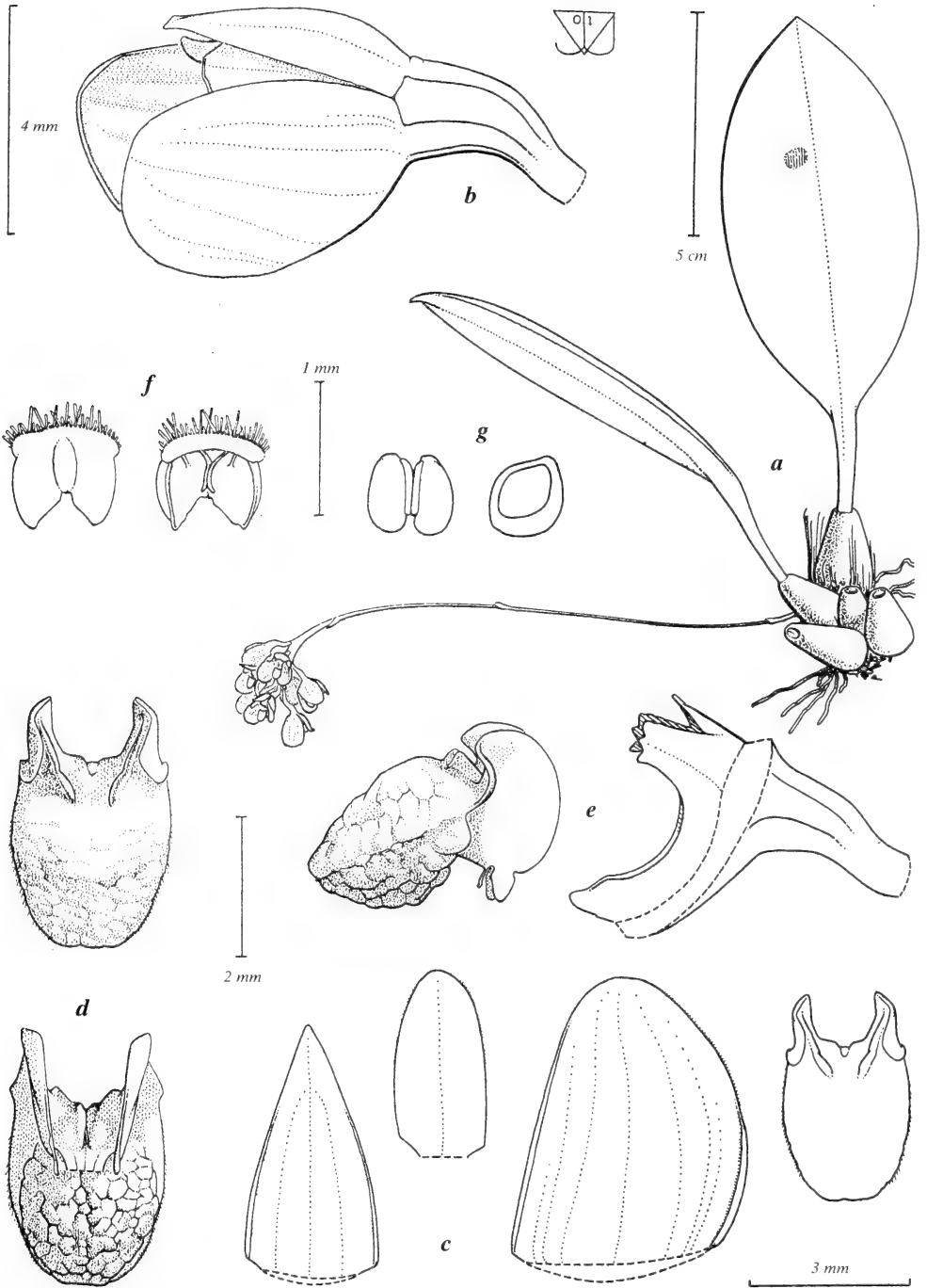


Figure 13. *Bulbophyllum cerebellum* J.J. Verm. (123)

front margin papillose, abaxially with many stiff hairs distally.

Colours: Plant medium green. Rhachis greenish, suffused with blackish purple. Sepals yellowish towards the base, cream-coloured towards the tip, suffused with reddish purple. Petals yellowish near the base, blackish purple elsewhere. Lip cream-coloured, marked with reddish purple, hairs yellow.

Habitat & ecology: Found as an epiphyte in open or closed primary evergreen forest on granite bedrock. Alt. 700—1500m. Flowering in Dec.

Distribution: VIETNAM: southern part (1 specimen seen).

Notes: All data on habitat, ecology and distribution are from L. Averyanov (pers. comm.). According to him, the inflorescence is up to 60 cm long and pendulous. The only specimen available to me has an incomplete inflorescence: the basal part is missing.

125. *Bulbophyllum penicillium* Par. & Rchb.f. in Rchb.f. – Fig. 15, plate 9.

Bulbophyllum penicillium Par. & Rchb.f. in Rchb.f., Trans. Linn. Soc. London, Bot. 30 (1874) 151; King & Pantling, Ann. Roy. Bot. Gard. (Calcutta) 8 (1898) 79, t. 108. – *Phyllorchis penicillium* (Par. & Rchb.f. in Rchb.f.) O. Kuntze, Rev. Gen. Pl. 2 (1891) 677. — TYPE: Myanmar, Moulmein, *Parish 303* (K, holo.; W iso.).

Bulbophyllum inopinatum W.W. Sm., Notes Roy. Bot. Gard. Edinburgh 8 (1915) 346. – TYPE: *Hort. Edinburgh s.n.* (E, holo.).

[Not *B. penicillium sensu* Rolfe, J. Bot. 23 (1885) 215; Rolfe in Vidal y Soler, Phaner. Cum. Philipp. (1885) 80 & 149; Vidal y Soler, Rev. Pl. Vasc. Filip. (1886) 267; Ames, Philipp. J. Sci. 7 (1912) 128; Ames, Enum. Philipp. Fl. Pl. 1 (1925) 392. – Specimen: *Cuming 2076* (BM, W; = *B. flavescens* [Bl.] Lindl., sect. *Aphanobulbon*).]

[Not *B. penicillium sensu* Seidenfaden, Opera Bot. 124 (1995) 47 (= *B. lanuginosum*).]

Rhizome 2.5—4 mm diam., sections between pseudobulbs 1.2—3.5 cm long. *Pseudobulbs* close or distant, ovoid, 1.8—3.5 x 1.5—2 cm, laterally flattened(?). *Petiole* 4—7.5 cm. *Leaf blade* elliptic to (ob-)ovate, 12.5—20.5 x 1.8—3.6 cm, index (length/width) 4.7—8.2; acute. *Inflorescence* an elongated, lax raceme, 28—65 cm, 16—65-flowered. *Peduncle* ± patent, 15—29 cm, bracts 4—6, the longest 10—15 mm long. *Rhachis* arching or nodding, spindle-shaped, 12—50 x c. 0.5 cm, glabrous. *Floral bracts* ovate to triangular, 4—8 x 2—4 mm, acuminate. *Flowers* not fully opening, several simultaneously. *Pedicel* and *ovary* 5.5—6.5 mm long, basal node ± flush with the surface of the rhachis. *Median sepal* ± porrect, ovate to triangular,

Figure 14. *Bulbophyllum clipeibulbum* J.J. Verm. (124) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, left: abaxial side, right: adaxial side; g. Pollinia, left: single pair, right: two pairs. – a (plant). From *Hort. Vienna 099-B-160-2* (living plant); a (inflorescence)—g. From *Hort. Salzburg OR 637/94* (spirit sample).

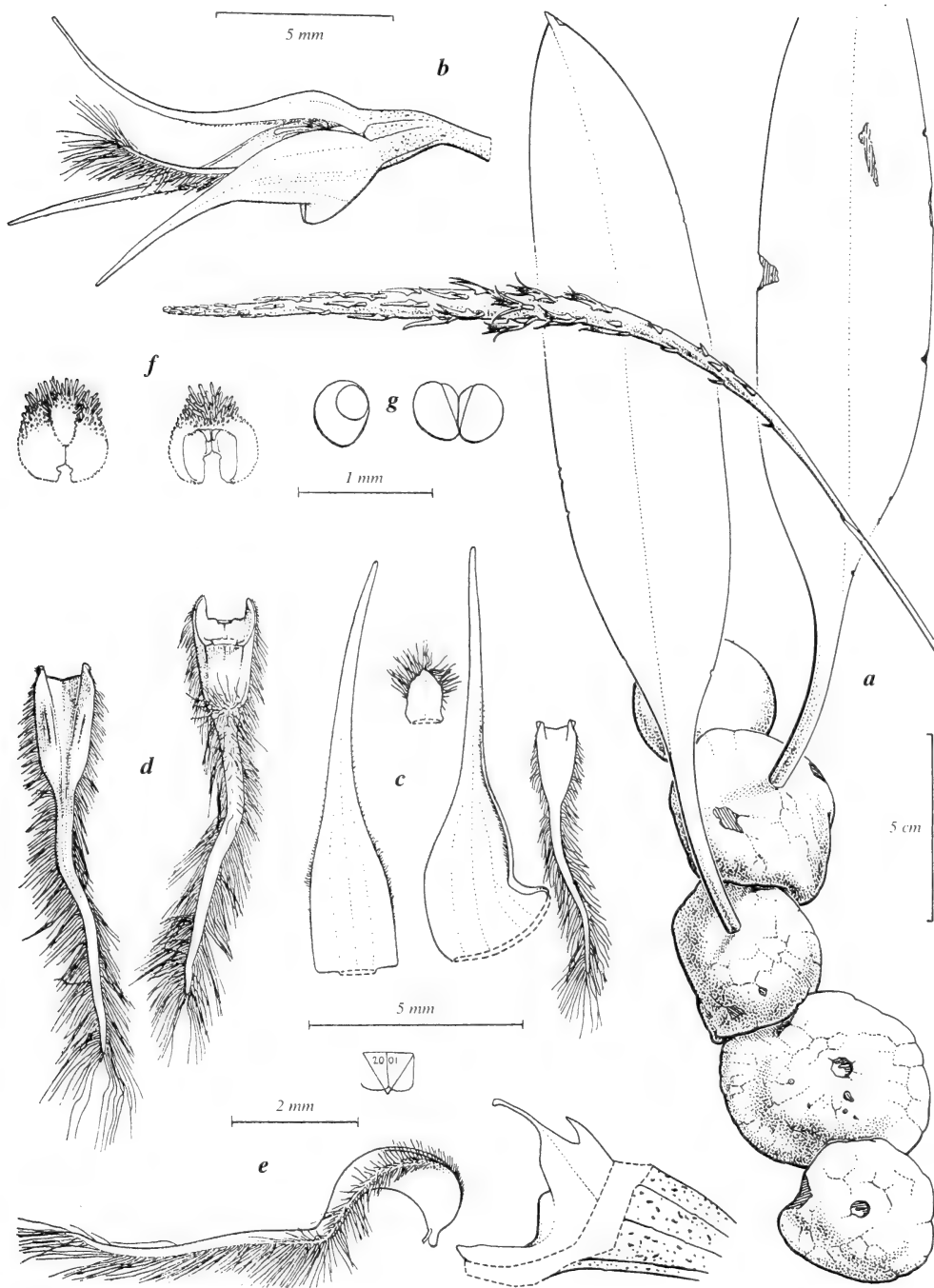


Figure 14. *Bulbophyllum clipeibulbum* J.J. Verm. (124)

7.5—12.5 x 1.8—3 mm, index 3.4—5.5; acute, margins very finely ciliate, base broadly attached; rather thin, surface glabrous. *Lateral sepals* recurved, 8—12 x 2.5—3.3 mm, index 2.9—4; upper margin glabrous, otherwise as the median sepal. *Petals* porrect, elliptic to ovate, 1—1.5 x 0.8—1.2 mm, index 1.2—1.4; rounded, margins long ciliate, base rather narrowly attached; rather thick, surface glabrous. *Lip* somewhat recurved in the basal half, ovate-subtriangular, 4—8 x 0.9—1.3 mm, index 4—6.7; gradually tapering towards a subacute tip, margins with stiff hairs over its entire length, those in the proximal third short, thin, those elsewhere short or long, slightly swollen; lip rather thick near the base, rather thin elsewhere; adaxially somewhat concave near the base, with three ridges, the lateral ridges low, rounded, towards the base almost touching over a deep slit before diverging, distally slightly diverging and continuing up to c. 1/2 of the lip, the median ridge starting near the ligament as a thick patch and continuing up to 1/3 of the lip as low, narrow, obtuse ridge, adaxial surface glabrous but slightly finely hirsute near the base; abaxially with a retuse ridge near the base, surface otherwise flat, glabrous. *Column* 1.8—3 mm long, stigma slightly protruding at its base. *Stelidia* subulate, 1—1.7 mm long, tip rounded; with an inconspicuous, rounded wing along the lower margin, at the base. *Anther*: front margin papillose and with some stiff hairs, abaxial ridge with scattered stiff hairs.

Colours: Rhachis dark brownish purple. Flowers greenish, marked with purple: sepals with purple veins, the lateral sometimes also with a purple blotch c. half-way; petals entirely purple, or with a purple top part, or with a purple vein and blotches along the margins; lip marked with purple or entirely purple; hairs on lip purple or pink with purple segments at irregular intervals.

Habitat & ecology: Alt. up to 2000 m. Flowering in Jan, Aug, Sep (May, Jun in cultivation).

Distribution: BHUTAN (1 specimen seen). INDIA: Assam (1). MYANMAR: Tenasserim (1).

Notes: In herbarium specimens the rhachis shrivels to about the same diameter as the peduncle; its thickness in fig. 15 has been estimated from the plate in King and Pantling (1898).

Figure 15. *Bulbophyllum penicillium* Par. & Rchb.f. in Rchb.f. (125) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, adaxial side; e. Lip, abaxial side; f. Column and lip, lateral view; g. Anther, above: abaxial side, below: adaxial side; h. Pollinia, left: two pairs, right: single pair. – a (plant). From *Parish 303*; a (inflorescence). From *Hort. Glasnevin s.n.*; b—h. From *O'Brien, d.d. 6-1895* (all herbarium specimens).

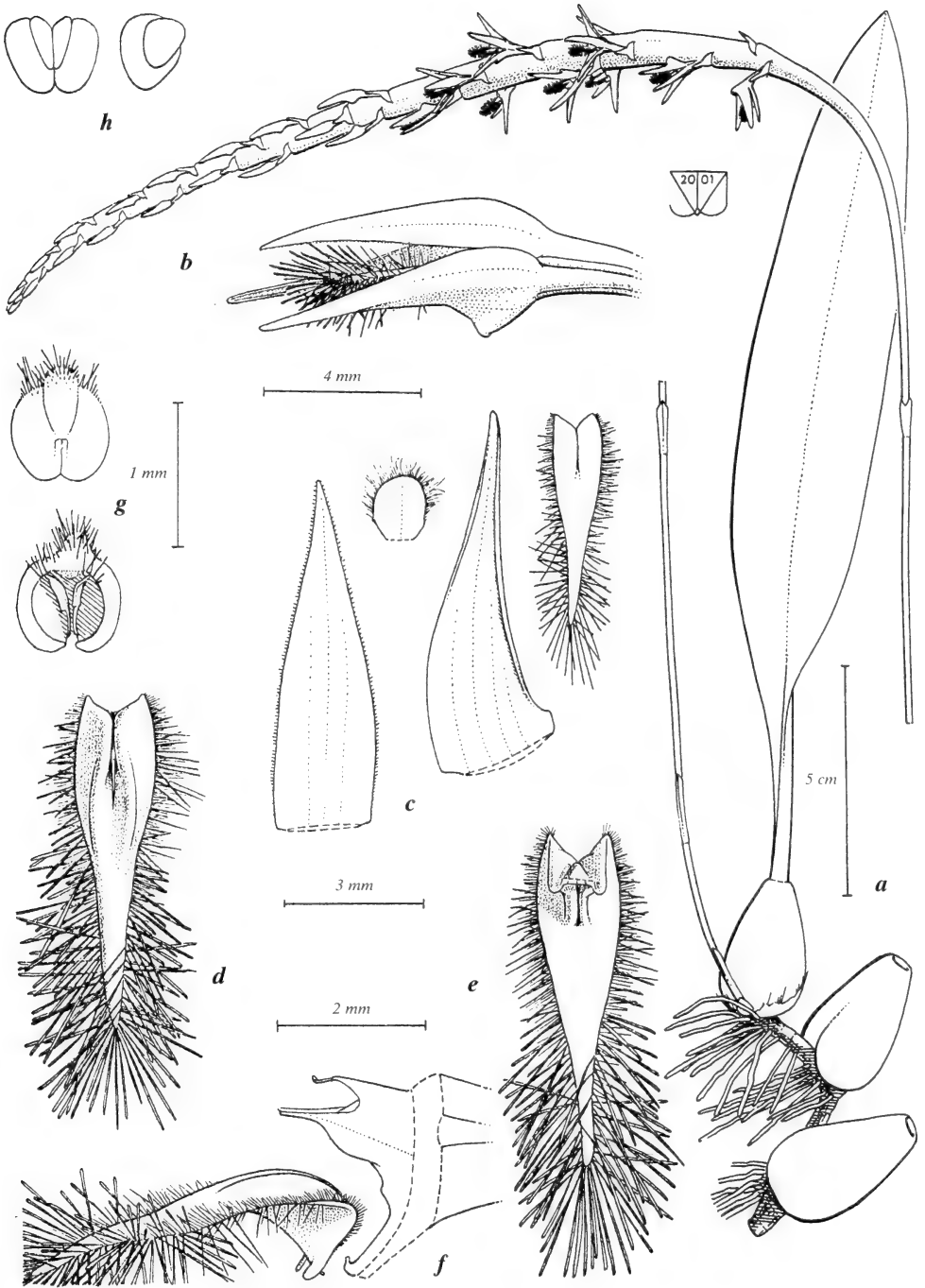


Figure 15. *Bulbophyllum penicillium* Par. & Rchb.f. in Rchb.f. (125)

126. *Bulbophyllum setuliferum* J.J. Verm. & L.G. Saw – Fig. 16, plate 10.

Bulbophyllum setuliferum J.J. Verm. & L.G. Saw, Gard. Bull. Singapore 52 (2000) 289.
 — TYPE: Malaysia, Pahang, Cameron Highlands, near Tanah Rata, *Hort. Singapore* SBG-O 490 (SING, holo.; KEP, KLU, iso.).

Rhizome 2.5—5 mm diam., sections between pseudobulbs 1.4—4 cm long. *Pseudobulbs* close or distant, depressed conical, 1.4—2.5 x 1.3—2.8 cm. *Petiole* 3—6.5 cm. *Leaf blade* elliptic to (ob-)ovate, 10—17 x 2—3.2 cm, index (length/width) 3.7—6.1; acute to slightly acuminate. *Inflorescence* an elongated, lax raceme, 33—80 cm, 22—68-flowered. *Peduncle* ± patent, 22—39 cm, bracts 5—6, the longest 6—9 mm long. *Rhachis* (slightly) nodding, spindle-shaped, flattened or not, 11—41 x 0.4—0.9 cm, glabrous, without blackish dots. *Floral bracts* triangular, 5—6.6 x 2—3.2 mm, acute. *Flowers* not much opening, one at a time or a few simultaneously. *Pedice*l and *ovary* 3—4 mm long, without blackish dots, basal node ± flush with the surface of the rhachis. *Median sepal* porrect or little incurved, triangular, 6—7.5 x 1.8—2 mm, index 3—3.8; acute, margins very finely ciliate, base rather broadly attached; rather thin, surface adaxially finely hirsute, abaxially glabrous. *Lateral sepals* recurved, 6—8 x 2.1—2.5 mm, index 2.6—3.3, upper margin glabrous; otherwise as the median sepal. *Petals* porrect, transversely elliptic to reniform, 0.7—0.8 x 0.9—1.1 mm, index 0.6—0.7; rounded, margins long ciliate, base narrowly attached; rather thin, surface glabrous. *Lip* slightly curved in the proximal half, subspathulate, 3.5—4 x c. 1.2 mm, index 2.9—3.3; truncate to rounded, margins ciliate along the proximal 2/3 of the lip and with long, slightly club-shaped hairs along the distal 2/3, the latter increasing in length and thickness towards the tip of the lip; very thick; adaxially concave near the base and near the tip, slightly convex in between, with a thin median slit up to 1/4—1/3 of the lip, with a distinct, narrow median ridge over ± the entire length of the lip and overtopping its front as a high crest, adaxial surface glabrous but finely hirsute near the base; abaxially with a retuse ridge towards the base, with a distinctly convex top part with scattered club-shaped hairs arising from tiny pits, surface otherwise glabrous. *Column* 1.5—2.1 mm long, column foot slightly swollen. *Stelidia* falcate, triangular, 0.5—1 mm long, acute, with a deltoid, rounded wing along the lower margin, at the base. *Anther*: front margin and abaxially towards the tip papillose with elongated papillae.

Figure 16. *Bulbophyllum setuliferum* J.J. Verm. & L.G. Saw (126) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, below: adaxial side, above: abaxial side; e. Column and lip, lateral view; f. Anther, above: abaxial side, below: adaxial side; g. Pollinia, left: single pair, right: two pair. – a. From *Hort. Singapore* SBG-O 490; b—g. From *Hort. Singapore* SBG-O 625 (both spirit samples).

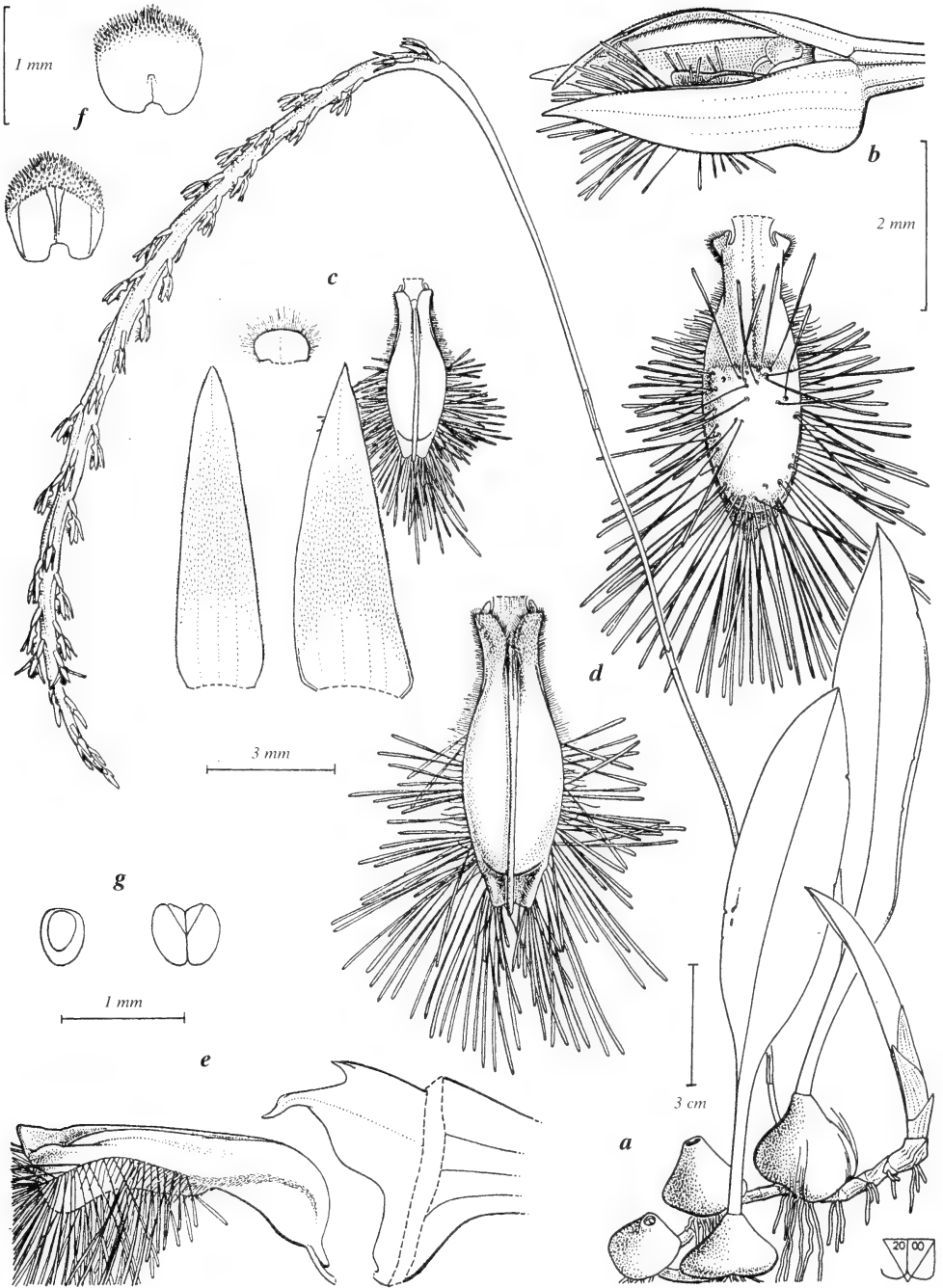


Figure 16. *Bulbophyllum setuliferum* J.J. Verm. & L.G. Saw (126)

Colours: Inflorescence and sepals pale green to whitish, suffused with dull reddish purple; the sepals proximally around the veins only. Petals translucent with a purple margin. Lip cream-coloured, with a purple margin, and often with some purple spotting on both surfaces. Hairs on lip shiny reddish purple, sometimes partly green. Column yellowish green, foot and wings below stelia marked with purple.

Habitat & ecology: In (lower) montane forest, on tree trunks and branches, in shade; also found in moss at the foot of a tree. Alt. 1500—1800 m. Flowering in Feb—Jun, Nov (May, Sep, Oct in cultivation).

Distribution: MALAYSIA: Peninsula (7 specimens seen).

127. *Bulbophyllum sororculum* J.J. Verm., sp. nov. – Fig. 17, plate 11.

Bulbophyllum sororculum J.J. Verm., a *Bulbophyllo aithorhachide* in inflorescentiis erectis, labello adaxialiter glabro differt. — TYPE: Indonesia, Sulawesi, central part, *M. Brans* s.n. (WU, holo.).

Rhizome 2.2—4 mm diam., sections between pseudobulbs 1.4—3 cm long. **Pseudobulbs** distant, (depressed) conical, 1—1.4 x 0.8—2.2 cm. **Petiole** 1.4—2.5 cm. **Leaf blade** elliptic, 6—13.5 x 1.4—2.6 cm, index (length/width) 3.3—5.8; acute. **Inflorescence** an elongated, lax raceme, erect to patent, c. 17 cm (not fully developed), c. 22-flowered. **Peduncle** c. 9.5 cm, bracts c. 4, the longest c. 8 mm long. **Rhachis** spindle-shaped, c. 7.5 x 0.4 cm (not fully developed), with many minute, blackish dots. **Floral bracts** triangular, c. 4.5 x 2.8 mm, acute. **Flowers** opening wide, a few simultaneously. **Pedicel** and **ovary** c. 2.5 mm long, with minute blackish dots, basal node on a c. 0.8 mm-long stump. **Median sepal** reflexed, ovate, c. 5.2 x 2 mm, index c. 2.6; acute, margins very finely ciliate, base rather narrowly attached; rather thick, surface adaxially sparsely hirsute, abaxially with few minute blackish dots near the base. **Lateral sepals** incurved to reflexed, triangular, c. 5 x 2.5 mm, index c. 2; acuminate, upper margin glabrous; otherwise as the median sepal. **Petals** porrect, (ob-)ovate, 1.2—2 x 1-1.2 mm, index 1.2—1.7; rounded, margins long ciliate towards the tip, base rather narrowly attached; rather thin, surface glabrous. **Lip** recurved in the proximal half, subspathulate, c. 3.2 x 1.1 mm, index 2.4—2.5; rounded, margins with long hairs increasing in length and thickness towards the tip of the lip; very thick; adaxially concave near the base, convex elsewhere, with a distinct, narrow median ridge embedded in a furrow over the distal 2/3 of the lip, protruding from

Figure 17. *Bulbophyllum sororculum* J.J. Verm. (127) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: abaxial side, right: adaxial side; e. Column and lip, lateral view; f. Anther, left: abaxial side, right: adaxial side; g. Pollinia, above: single pair, below: two pairs. – All from *M. Brans* s.n. (spirit sample).

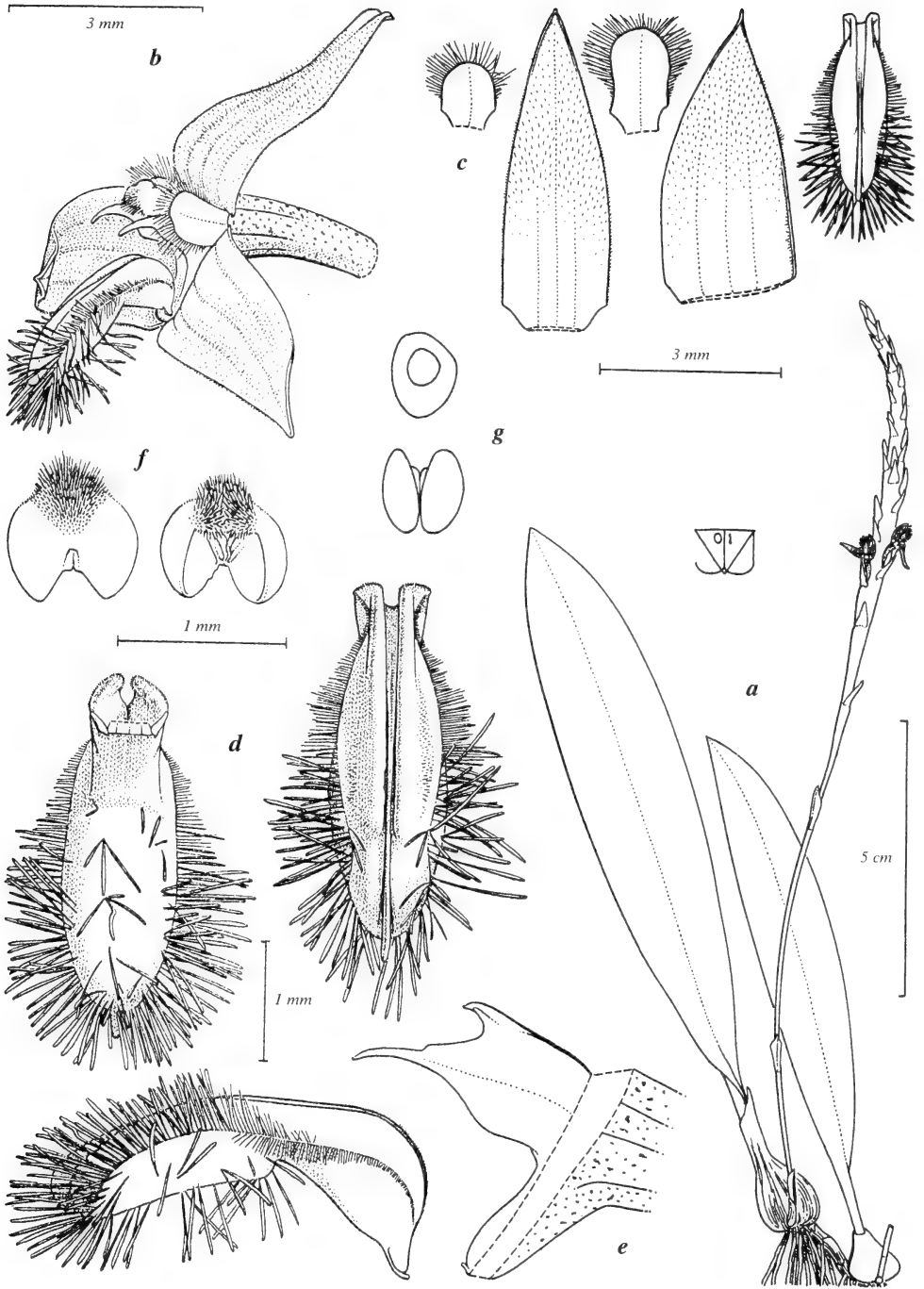


Figure 17. *Bulbophyllum sororculum* J.J. Verm. (127)

the furrow in the distal 1/3 and overtopping its front as a high crest, adaxial surface glabrous but finely hirsute near the base; abaxially with a retuse ridge towards the base, with a distinctly convex top part with scattered club-shaped hairs, surface otherwise glabrous. *Column* c. 2 mm long, column foot slightly swollen, abaxially without a spur near the tip. *Stelidia* slightly falcate, subulate, c. 1.1 mm long, acute, with a deltoid, obtuse wing along the lower margin, at the base. *Anther*: front margin and abaxial ridge densely papillose with elongated papillae.

Colours: Rhachis dull purplish red with tiny green spots. Floral bracts green, suffused with dull purple. Sepals greenish, heavily spotted with dull purple. Petals greenish at base, white in the middle, grading into a blackish purple top part; hairs yellow. Lip greenish at the base, yellowish elsewhere, margins and median crests almost black, elsewhere with almost black spots.

Habitat & ecology: Epiphyte in primary forest, on the bole of a tree c. 3 m above the ground, at c. 500 m alt. Flowering in Oct, Nov in cultivation.

Distribution: INDONESIA: Sulawesi, central part (1 specimen seen).

Notes: *Bulbophyllum sororculum* is in some respects intermediate between *B. setuliferum* and *B. aithorhachis*. The former differs in having a lip with a concave top part, the latter in having a pendulous inflorescence and a lip that is hirsute distally on the adaxial side; and both differ in having less elongated petals.

One of the flowers available had the two petals of different lengths.

The species is remarkable for the asymmetrically opening flowers: these are kept so close to the rhachis that the lateral sepal facing the rhachis cannot spread properly.

128. *Bulbophyllum aithorhachis* J.J. Verm. – Fig. 18, plate 12, 13.

Bulbophyllum aithorhachis J.J. Verm., *Blumea* 41 (1996) 349. — TYPE: Brunei, Sungei Ingei, surroundings of Batu Melintang, *Jongejan cult.* 2219 (L, holo.).

Rhizome 3–4 mm diam., sections between pseudobulbs 1–2.5 cm long. *Pseudobulbs* close or distant, depressed conical, 0.6–1.4 x 1.1–2.2 cm. *Petiole* 0.8–3.8 cm. *Leaf blade* elliptic to ovate, 9–16 x 1.7–4 cm, index (length/width) 4.0–5.3; acute. *Inflorescence* an elongated, lax raceme, pendulous, 27–50 cm, 22–50-flowered. *Peduncle* 16–28 cm, bracts 4–5, the longest 7–12 mm long. *Rhachis* spindle-shaped, 10–22 x 0.8–1.2 cm, with many minute blackish dots. *Floral bracts* triangular, 3.5–4 x 4–5

Figure 18. *Bulbophyllum aithorhachis* J.J. Verm. (128) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Column and lip, lateral view; f. Anther, above: abaxial side, below: adaxial side; g. Pollinia, left: two pairs, right: single pair. – All from *Jongejan cult.* 2219 (spirit sample).

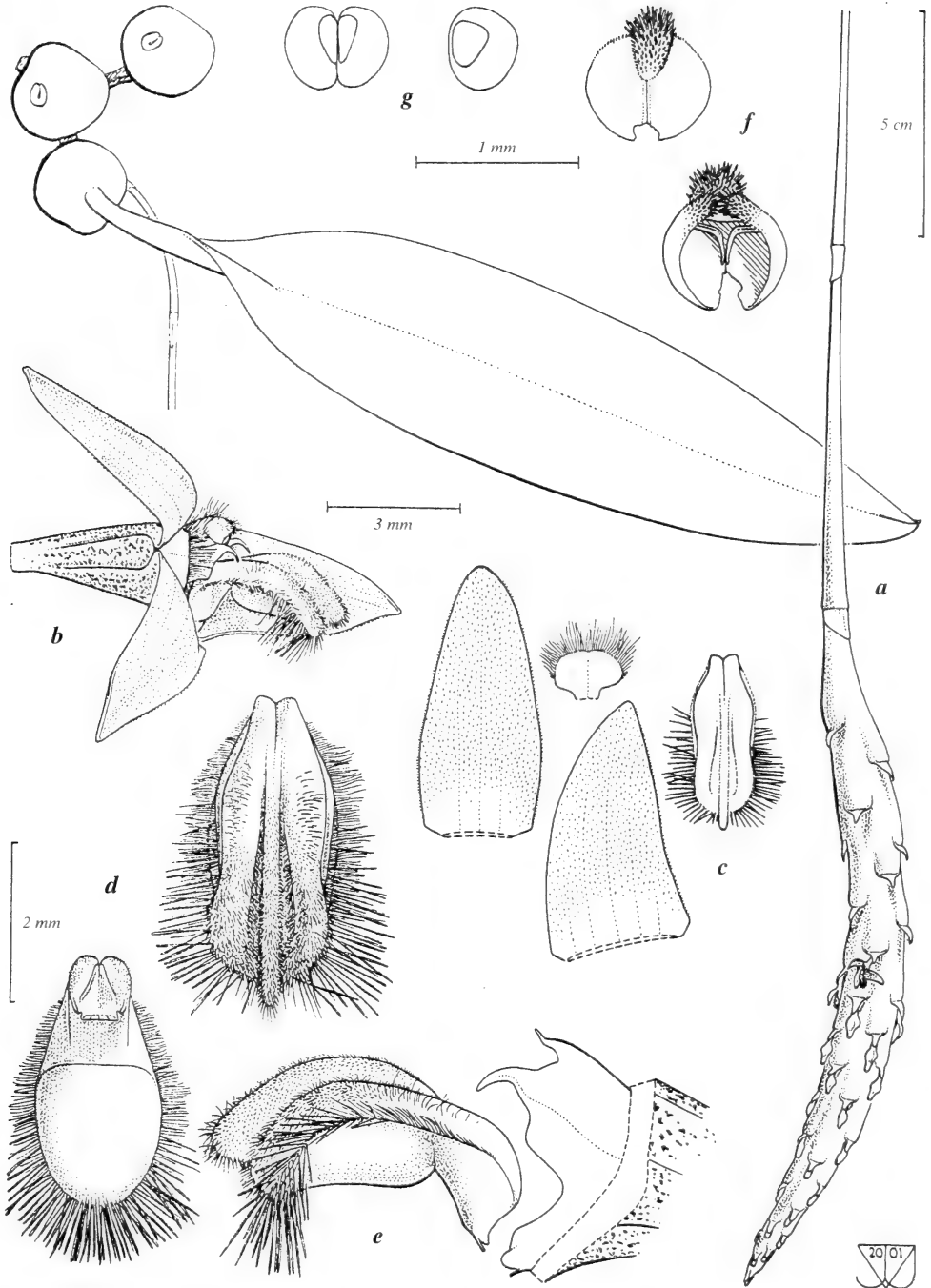


Figure 18. *Bulbophyllum aithorhachis* J.J. Verm. (128)



mm, acute. *Flowers* opening wide, a few simultaneously. *Pedice*l and *ovary* c. 4 mm long, with many minute blackish dots, basal node \pm flush with the surface of the rhachis. *Median sepal* recurved to reflexed, ovate, 5.5—6 x 2—2.5 mm, index 2.2—3; obtuse, margins very finely ciliate, base rather broadly attached; rather thick, surface adaxially sparsely hirsute, abaxially with few minute blackish dots near the base. *Lateral sepals* porrect to spreading, triangular, 5.2—6.2 x 2.2—3 mm, index 1.7—2.9, upper margin glabrous; otherwise as the median sepal. *Petals* porrect, transversely elliptic to reniform, 0.8—1.2 x 1.3—1.6 mm, index 0.6—0.8; rounded, margins long ciliate towards the tip, base narrowly attached; rather thick, surface glabrous. *Lip* abruptly recurved in the proximal half, obovate, 3.3—4 x c. 1.3 mm, index 2.4—2.5; rounded, margins with long hairs increasing in length and thickness towards the tip of the lip; very thick; adaxially hardly concave and with two proximally diverging calli near the base, with a median slit up to 1/4 of the lip, with three distinct, obtuse ridges almost from base to tip, the lateral low and wide, diverging proximally and distally, running parallel and close together \pm half-way up the lip, the median ridge high and narrow, starting in the proximal half and overtopping the front of the lip as a high crest, adaxial surface irregularly hirsute except near the base; abaxially with a wide, retuse ridge towards the base, convex towards the tip, surface finely velutinous distally, glabrous proximally. *Column* c. 2 mm long, column foot slightly swollen. *Stelidia* falcate, triangular, c. 0.7 mm long, acute, with a deltoid, obtuse wing along the lower margin, at the base. *Anther*: front margin and abaxial ridge densely papillose with elongated papillae.

Colours: Rhachis, pedicel and ovary pale greenish, suffused with reddish purple. Flowers pale greenish or yellow, the parts marked with dark reddish purple: the sepals spotted, particularly towards the margins and near the veins, the petals along the top margin, the lip adaxially towards the margins, abaxially towards the tip. Cilia along the petals and thicker hairs along the top part of the lip dark reddish purple; but hairs on the midrib and fine hairs along the margins of the lip white.

Habitat & ecology: Primary forest. Alt. 50—800 m. Found with mature fruits in Apr.

Distribution: BRUNEI (1 specimen seen). INDONESIA: Sumatra (1).

Notes: As in the previous species, the flowers cannot open completely because they are held so close to the rhachis that the lateral sepal facing the rhachis is trapped in between.

The Sumatra specimen only has fruits and could either be this or *B. setuliferum*. On account of the very thin peduncle (indicating a pendulous inflorescence), the rhachis structure, and the length of the floral bracts, it has been included here.

129. *Bulbophyllum echinochilum* F. Kraenzl. – Fig. 19. (*probably extinct*)
Bulbophyllum echinochilum F. Kraenzl., Repert. Spec. Nov. Regni Veg. 17 (1921) 385;
 Ames, Sched. Orch. 6 (1923) 81. — TYPE: Philippines, Manila, *Hort. Muenchen*
 (*Loher s.n.*) d.d. 1916 (B[?], holo., destroyed; AMES, iso.).

Pseudobulbs close or distant, depressed conical, 1.2—2.5 x 1.6—2.0 cm. *Petiole* c. 1.1 cm. *Leaf blade* elliptic, 7.5—10 x 1.4—2 cm, index (length/width) 5—5.3. *Inflorescence* an elongated, lax raceme c. 17 cm, 18—20-flowered. *Peduncle* ± patent, c. 9 cm. *Rhachis* arching or nodding, spindle-shaped, c. 8 x 0.5 cm. *Pedicel* and *ovary* c. 3—4 mm long, with scattered minute blackish dots. *Median sepal* recurved to reflexed, ovate, c. 5.8 x 1.7 mm, index c. 3.4; acute, margins very finely ciliate, base rather broadly attached; rather thin, surface adaxially finely hirsute, abaxially with few minute, blackish dots near the base. *Lateral sepals* recurved, subtriangular, c. 6 x 2 mm, index c. 3, upper margin finely papillose; otherwise as the median sepal. *Petals* porrect, elliptic, c. 1.2 x 1 mm, index c. 1.2; rounded, margins long ciliate, base narrowly attached; thin, surface glabrous except for a small tuft of hairs on the abaxial side. *Lip* almost straight, ± elliptic, c. 3.7 x 0.9 mm, index c. 4.1; rounded, margins ciliate except near the base and near the tip and with long, ± straight, slightly club-shaped hairs along the distal 2/3, the latter increasing in length towards the tip of the lip; very thick; adaxially concave near the base, with three distinct, obtuse ridges, the two lateral ridges wide, diverging proximally, the median higher and narrow, all three ridges fusing into a single ridge well before the front of the lip, adaxial surface glabrous but finely hirsute near the base; abaxially with a weak, retuse ridge towards the base, with a distinctly convex top part with scattered club-shaped hairs arising from tiny pits, surface otherwise glabrous. *Column* c. 1.8 mm long, column foot slightly swollen. *Stelidia* slightly falcate, triangular, c. 0.7 mm long, acute.

Colours: Pseudobulbs reddish. Rhachis dull purple with white spots. Sepals yellowish green, with tiny reddish brown dots. Petals white with reddish brown margins. Lip yellowish green, hairs yellowish brown.

Habitat & ecology: Flowering in Dec in cultivation.

Distribution: PHILIPPINES: Luzon (1 specimen seen). Not collected since c. 1910.

Notes: Only known from an incomplete isotype specimen. The description of the vegetative parts has been copied from Kraenzlin's description and his notes with the isotype material.

Ames (1923) doubted its provenance on account of a superficial resemblance to African species. As it fits well in sect. *Hirtula*, however, it is clearly of Asian origin.

130. *Bulbophyllum lanuginosum* J.J. Verm., sp. nov. – Fig. 20.

Bulbophyllum lanuginosum J.J. Verm., a *Bulbophyllo penicillio* labello adaxialiter crista distincta, pilis lanatis secus margines differt. — TYPE: Thailand, purchased on Bangkok market, *Thaitong 1395* (C, holo.).

Bulbophyllum penicillium sensu Seidenfaden, *Opera Bot.* 124 (1995) 47, **colour photograph pl. 9b**, non Par. & Rchb.f. in Rchb.f.

Rhizome c. 2 mm diam., sections between pseudobulbs c. 0.6 cm long. *Pseudobulbs* ?close, ovoid, c. 1.2 x 1.2 cm. *Petiole* 1.5 cm. *Leaf blade* elliptic, c. 9 x 1.5 cm, index (length/width) c. 6; acute. *Inflorescence* an elongated, lax raceme, 9.5–14 cm, 16–20-flowered. *Peduncle* ± erect, 3–4 cm, bracts c. 4, the longest 4–4.5 mm long. *Rhachis* erect, swollen, ± circular in section, 6.5–10 x c. 0.15 cm, glabrous. *Floral bracts* triangular, 2.5–3 x 1.5–1.8 mm, acute. *Flowers* opening wide, one at a time or a few simultaneously. *Pedicel* and *ovary* 2–2.2 mm long, without minute blackish dots, basal node on a 0.7–1 mm-long stump. *Median sepal* spreading to reflexed, triangular, c. 6.5 x 1.9 mm, index c. 3.4; acute, margins very finely ciliate, base rather broadly attached; rather thin, surface adaxially very finely hirsute locally, abaxially glabrous. *Lateral sepals* c. 6 x 2 mm, index c. 3, upper margin ± glabrous; otherwise as the median sepal. *Petals* porrect, transversely elliptic, c. 0.9 x 1.2 mm, index 0.7–0.8; subacute, margins long ciliate, base narrowly attached; thin, surface glabrous. *Lip* somewhat recurved in the basal half, ± oblong, c. 3 x 0.9 mm, index 3.3–3.4; rounded, margins ciliate near the base and with long, thin, wavy hairs near the tip, with shorter, thin, ± straight hairs in between; very thick; adaxially slightly concave and with two calli near the base, with a thin median slit up to c. 1/3 of the lip, with three distinct, obtuse ridges fused into a crest that increases in height into a high and narrow wedge distally, the two lateral ridges wide, diverging proximally, forming the edges of the wedge distally, the median ridge narrow, ending just before the end of the wedge, adaxial surface glabrous but finely hirsute near the base; abaxially with a retuse ridge towards the base, with a distinctly convex top part with long, thin, wavy hairs, surface otherwise glabrous. *Column* c. 1.6 mm long, stigma protruding at its base. *Stelidia* subulate, c. 0.9 mm long, acute, with a large, antrorse, triangular, acute tooth along the upper margin. *Anther*: front margin papillose, abaxially towards the tip with elongated papillae.

Colours: Rhachis, bracts, pedicel and ovary greenish. Flowers greenish; sepals with brownish purple veins, petals with brownish purple

Figure 19. *Bulbophyllum echinophilum* Kraenzl. (129) – a. Pseudobulb and leaf; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Column and lip, lateral view. – All from *Hort. Muenchen (Loher s.n.) d.d. 1916* (poor quality herbarium specimen).

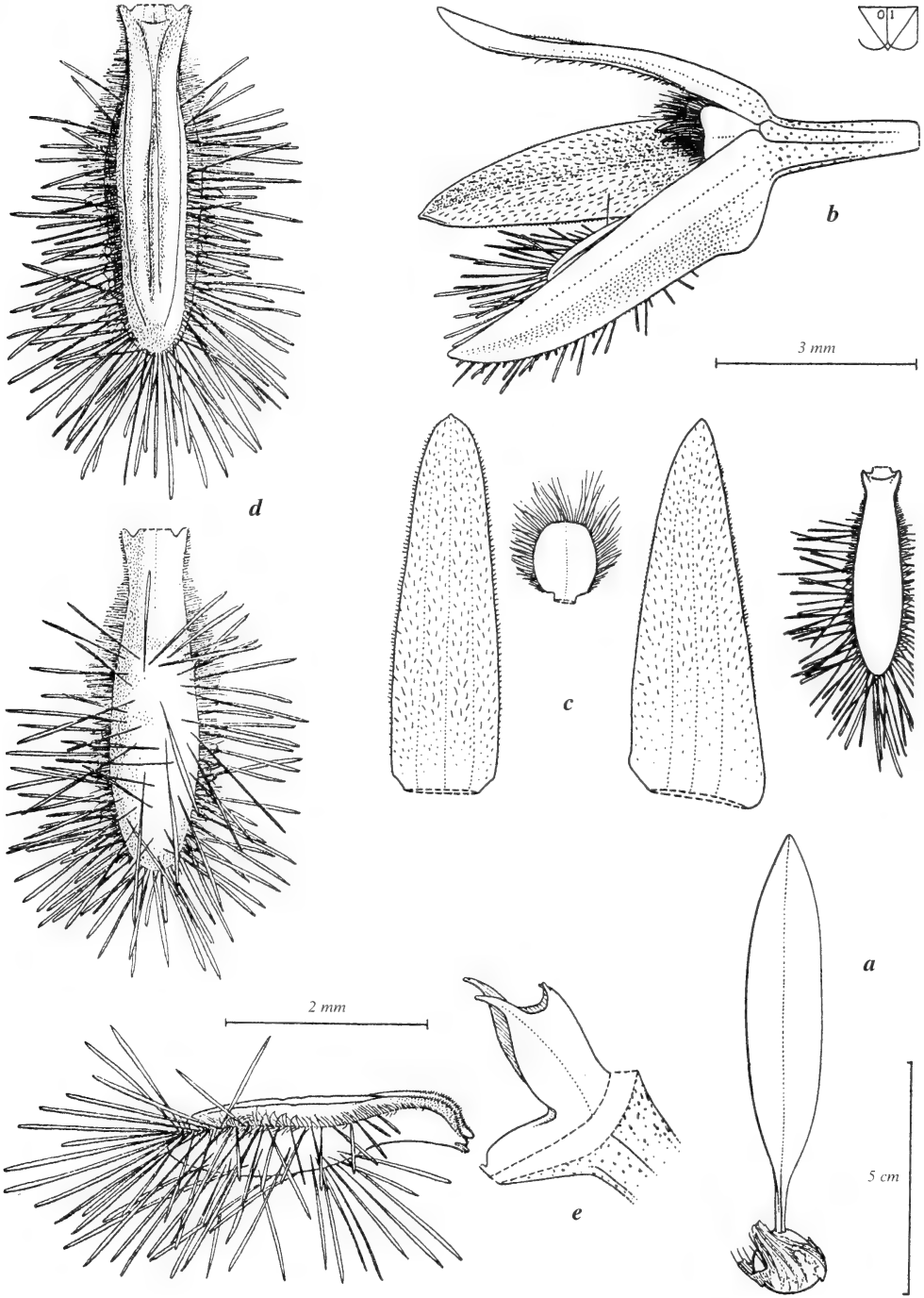


Figure 19. *Bulbophyllum echinochilum* Kraenzl. (129)

hairs, and lip with the lateral crests and the abaxial side similarly coloured. Shorter, stiff hairs on lip purple, the long, wavy hairs white.

Habitat & ecology: Flowering observed in Jun.

Distribution: THAILAND: 'probably Kanburi area' (1 specimen seen).

Notes: Only known from the type specimen. The description of the vegetative parts is not complete.

Erroneously identified by Seidenfaden (1995) as *B. penicillium*; it differs from that species in its smaller stature, shorter peduncle, its crested, obtuse lip with woolly, wavy hairs (hence the specific epithet).

131. *Bulbophyllum atratum* J.J. Sm. – Fig. 21, plate 14.

Bulbophyllum atratum J.J. Sm., Bull. Jard. Bot. Buitenzorg, s. 2, 25 (1917) 73. – TYPE: Indonesia, Sumatra, Barisan Range, *Hort. Bogor* (leg. Ajoeb, Exp. Jacobson) 862 (BO, holo., not seen, likely isotypes in L).

Rhizome 1–2 mm diam., sections between pseudobulbs 0.4–0.8 cm long. *Pseudobulbs* touching, ovoid, 0.5–1.0 x 0.6–1 cm. *Petiole* 2–3 cm. *Leaf blade* elliptic to ovate, 10–14.5 x 2.5–4.3 cm, index (length/width) 3.3–4.6; obtuse. *Inflorescence* an elongated, rather lax to rather dense raceme, entirely pendulous, 35–50 cm, 8-40-flowered. *Peduncle* 25–33 cm, bracts 4–5, the longest 6–10 mm long. *Rhachis* swollen, ± circular in section, 9.5–16.5 x 0.3–0.5 cm, glabrous, top 2–7 cm with minute, sterile bracts only. *Floral bracts* triangular, 0.8–1 x 1–1.2 mm, acuminate. *Flowers* not fully opening, many simultaneously. *Pedicel* and *ovary* 2.3–3 mm long, papillose-hirsute, basal node on a 0.2–0.3 mm-long stump. *Median sepal* ± porrect and incurved distally, triangular, 5–5.5 x 1.5–2 mm, index 2.5–3.7; acute, margins ciliolate, base broadly attached; rather thin, surface adaxially glabrous, abaxially papillose-hirsute. *Lateral sepals* (slightly) recurved, falcate, 4–4.2 x 2.5–2.9 mm, index 1.3–1.7; otherwise as the median sepal. *Petals* porrect, falcate, ovate with or without two minute teeth proximally along the lower margin, 3.5–4 x 1.2–1.5 mm, index 2.5–2.9; acute, margins ciliate with cilia longer towards the tip, base narrowly attached; thin, surface glabrous except for a few hairs near the tip. *Lip* abruptly recurved c. half-way, elliptic to obovate, 1.8–2.2 x 1–1.3 mm, index 1.5–2; rounded, margins ciliate except near the base; very thick; adaxially hardly concave and with 2 inconspicuous calli and a short

Figure 20. *Bulbophyllum lanuginosum* J.J. Verm. (130) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, left: adaxial side, right: abaxial side; g. Pollinia, left: two pairs, right: single pair. – All from *Thaitong 1395* (spirit sample).

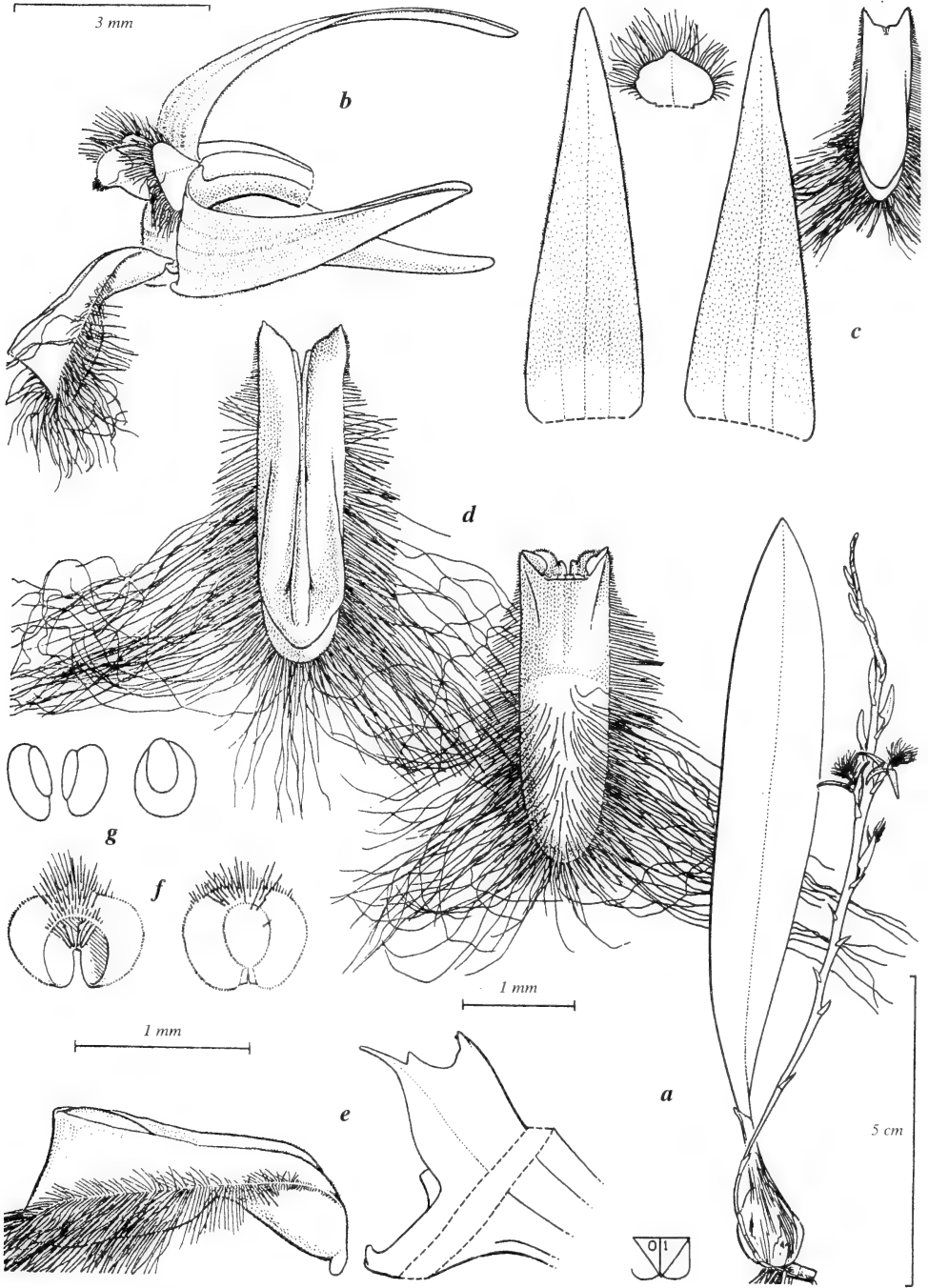


Figure 20. *Bulbophyllum lanuginosum* J.J. Verm. (130)

median slit near the base, with two weak, obtuse ridges that are proximally diverging and running parallel and close to the median line up to near the tip, adaxial surface glabrous; abaxially with a wide, retuse ridge and glabrous towards the base, convex and papillose-hirsute towards the tip. *Column* c. 1.5 mm long, stigma slightly protruding at its base, column foot abaxially without a spur near the tip. *Stelidia* c. 0.6 mm long, acute, \pm rectangular in outline with a distinct, antrorse, deltoid, obtuse to acute tooth along the upper margin and often along the lower margin. *Anther*: front margin papillose with elongated papillae, abaxial ridge \pm glabrous.

Colours: Peduncle dark green at the base, blotched with maroon towards the tip, rhachis brownish or dark maroon, almost black. Flowers yellowish or cream coloured near the base, whitish towards the tip, sepals with partially or entirely blackish purple veins and margins, the lateral sometimes with large blackish purple spots instead of coloured veins; petals without blackish markings. Lip blackish towards the tip, white towards the base, with fine red spots adaxially. Column and anther creamy white.

Habitat & ecology: Epiphyte in montane forest. Alt. c. 1000 m. Flowering in Mar, Nov.

Distribution: MALAYSIA: Peninsula (2 specimens seen). INDONESIA: Sumatra (2).

Notes: Specimens from Peninsular Malaysia with wider leaves than in the description above have been seen in cultivation.

132. *Bulbophyllum groeneveldtii* J.J. Sm. – Fig. 22, plate 15.

Bulbophyllum groeneveldtii J.J. Sm., Bull. Jard. Bot. Buitenzorg, s. 3, 2 (1920) 95. – TYPE: Indonesia, Sumatra, Padang Highlands, *Jacobson cult.* 951 (*leg. Groeneveldt*) (BO, holo).

Rhizome c. 3 mm diam., sections between pseudobulbs c. 0.4 cm long. *Pseudobulbs* touching, (depressed) globose, 0.4–0.7 x 0.4–1.2 cm. *Petiole* 0.3–0.5 cm. *Leaf blade* elliptic to obovate, 8–28 x 0.8–3.3 cm, index (length/width) 8.3–12.5; obtuse. *Inflorescence* an elongated, lax raceme, entirely pendulous, 7–18 cm, up to 45-flowered. *Peduncle* 4–7 cm, bracts c. 4, the longest c. 2 mm long. *Rhachis* swollen, \pm circular in section, 3.5–12 x 0.2–0.3 cm, papillose-hirsute, to the very tip with flowers. *Floral bracts* triangular, c. 1.5 x 1 mm, acute. *Flowers* not much opening, a few simultaneously. *Pedicel* and *ovary* 1.5–2.6 mm long, papillose-hirsute,

Figure 21. *Bulbophyllum atratum* J.J. Sm. (131) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, left: adaxial side, right: abaxial side; g. Pollinia, above: two pairs, below: single pair. – All from *Hort. Singapore SBG-O 87* (spirit sample).

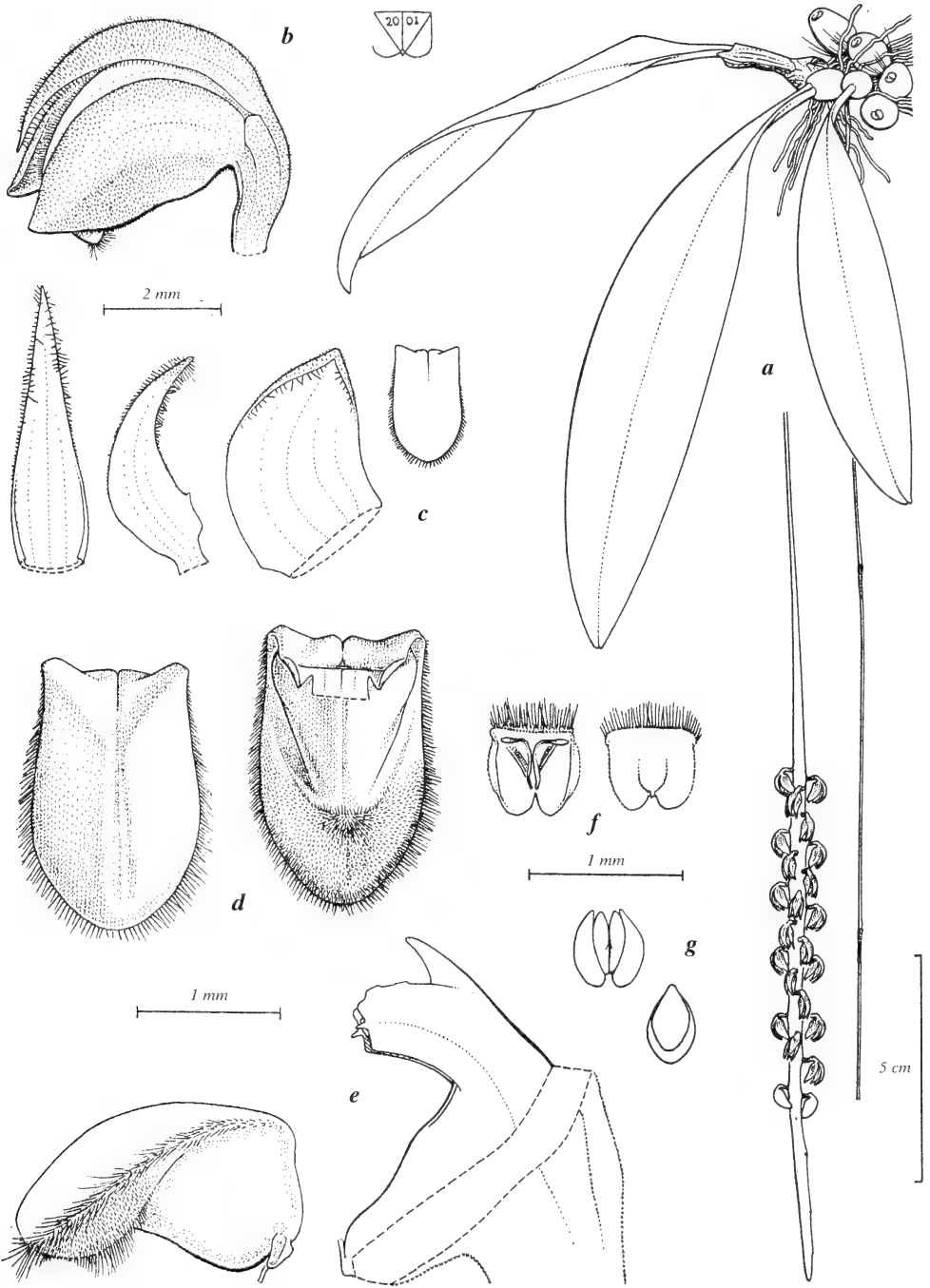


Figure 21. *Bulbophyllum atratum* J.J. Sm. (131)

basal node \pm flush with the surface of the rhachis. *Median sepal* \pm porrect, triangular, 3.2–3.3 x 1.3–1.5 mm, index 2.1–2.5; acute, margins papillose-hirsute, base rather broadly attached; rather thick, surface adaxially glabrous, abaxially papillose-hirsute. *Lateral sepals* slightly recurved, 3.3–3.5 x 2.2–3 mm, index 1.1–1.5; otherwise as the median sepal. *Petals* porrect, falcate or not, hastate with an ovate, acute top part with ciliate margins, and a triangular, acute tooth along upper and lower margin, near the base; 1.6–2.2 x 1.2–1.5 mm, index 1–1.8, base rather broadly attached; rather thin, surface glabrous. *Lip* abruptly recurved in the basal half, elliptic, 2–2.4 x 0.9–1.5 mm, index 1.6–2.2; rounded, margins ciliate in the proximal third; very thick; adaxially not concave and with a short median slit near the base, with two weak, obtuse ridges proximally diverging, and running parallel and close to the median line up to near the tip, adaxial surface glabrous but hirsute near the base and in the top half; abaxially with a wide, rounded ridge towards the base, convex and with scattered coarse hairs towards the tip, surface otherwise glabrous. *Column* 1–1.3 mm long, stigma with an inconspicuous, rounded callus at its base, column foot with two inconspicuous wings distally, abaxially without a spur near the tip. *Stelidia* \pm triangular, c. 0.6 mm long, acute, with 2 small, antrorse, deltoid, acute teeth along the upper margin and 1 \pm similar tooth along their lower margin. *Anther*: front margin papillose with elongated papillae, abaxial ridge \pm glabrous.

Colours: Flowers yellow or pale green, sepals and petals with partially or entirely brown or blackish purple veins and margins, sometimes with additional spots; petals with brown or blackish purple cilia. Lip entirely blackish, or blackish towards the tip only, except for the midvein.

Habitat & ecology: Understorey epiphyte in high montane forest and in low and open *kerangas* forest. Rooting in small humus deposits and moss. Alt. 1100–1300 m. Flowering in Jan, Oct–Dec.

Distribution: MALAYSIA: Sabah (4 specimens seen). INDONESIA: Sumatra (1).

Notes: When sterile, it is characterised by the pendulous, almost strap-shaped leaves.

133. *Bulbophyllum grotianum* J.J. Verm., *sp. nov.* – Fig. 23, plate 16, 17.

Bulbophyllum grotianum J.J. Verm., a *Bulbophyllo atrato* et *B. groeneveldtii*

Figure 22. *Bulbophyllum groeneveldtii* J.J. Sm. (132) — a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Column and lip, lateral view; f. Anther, above: adaxial side, below: abaxial side; g. Pollinia, left: two pairs, right: single pair. – All from *Vermeulen 1107* (living plant).

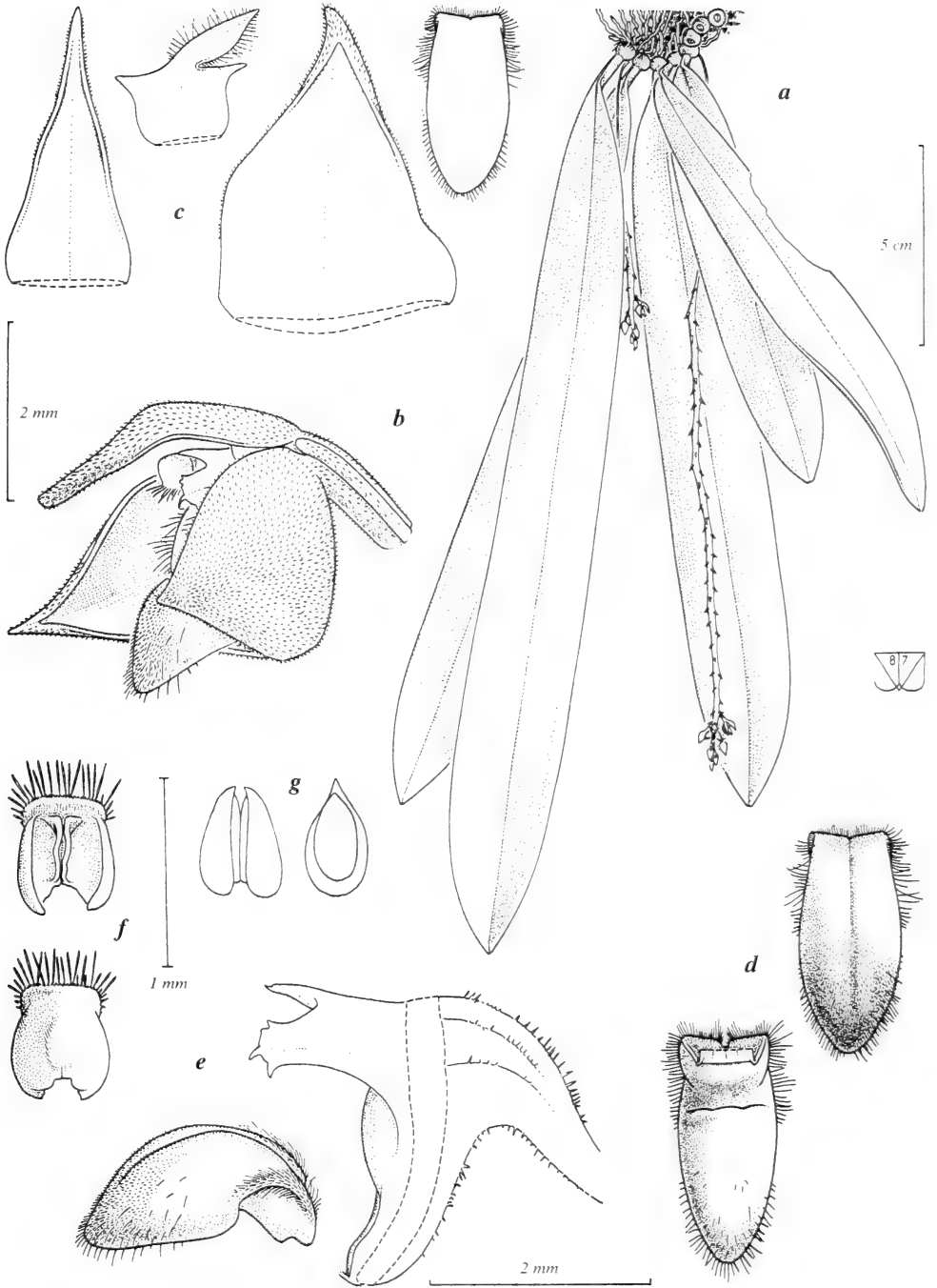


Figure 22. *Bulbophyllum groeneveldtii* J.J. Sm. (132)

inflorescentia erecta, rhachide nutanti 0.6—0.7 cm crassa differt. – TYPE: Malaysia, Sarawak, G. Mulu area, G. Pala near Batu Bulang, *Hort. Leiden* 970530 (L. holo.).

Rhizome 4—5 mm diam., sections between pseudobulbs 0.4—1 cm long. *Pseudobulbs* touching, ovoid, 0.4—0.8 x 0.4—0.8 cm. *Petiole* 1.2—2.2 cm. *Leaf blade* elliptic, 8—16.5 x 2.8—3 cm, index (length/width) 2.3—5.7; rounded. *Inflorescence* an elongated, rather dense raceme, 17.5—23.5 cm, 45—65-flowered. *Peduncle* ± erect, 13—16 cm; bracts c. 4, the longest c. 5.5 mm long. *Rhachis* nodding, spindle-shaped, 4.5—7.5 x 0.6—0.7 cm, papillose-hirsute, to the very tip with flowers. *Floral bracts* triangular, 0.9—1.3 x c. 1 mm, cuspidate. *Flowers* not much opening, several simultaneously. *Pedicel* and *ovary* 1.8—2 mm long, hirsute, basal node ± flush with the surface of the rhachis. *Median sepal* ± porrect, triangular, 3—3.4 x 1.2—1.9 mm, index 1.7—2.5; acute, margins ciliate, base rather broadly attached; rather thick, surface adaxially glabrous, abaxially hirsute. *Lateral sepals* slightly recurved, 3—3.2 x 2.2—2.5 mm, index 1.2—1.4, acuminate-cuspidate, otherwise as the median sepal. *Petals* porrect, ovate-subhastate with an inconspicuous, deltoid, acute tooth along upper and lower margin, 2.2—2.8 x 0.7—1 mm, index 2.8—3.2; acute, margins ciliate except near the base, base rather broadly attached; rather thin, surface glabrous. *Lip* abruptly recurved c. half-way, obovate, 1.6—1.8 x 1.1—1.3 mm, index 1.3—1.5; broadly rounded, margins ciliate; very thick; adaxially somewhat concave and with a short median slit near the base, with two weak, rounded ridges starting in the proximal half and slightly diverging close to the tip, with a small cavity in between, adaxial surface glabrous but very finely papillose towards the base; abaxially with a wide, retuse ridge towards the base, convex towards the tip, surface glabrous. *Column* 1—1.2 mm long, column foot abaxially without a spur near the tip. *Stelidia* ± triangular, 0.4—0.5 mm long, acute, with an antrorse, minute, triangular, acute tooth along the upper margin, and 2 larger, narrowly triangular, acute teeth along the lower margin, the proximal falcate. *Anther*: front margin ciliate, abaxial ridge somewhat papillose.

Colours: Flowers cream-coloured or yellowish, marked with blackish purple: the median sepal along the veins and margins; the lateral sepals also with a blotch near the tip; the lip near the base with dots, the tip entirely blackish purple abaxially. Column and anther cream-coloured.

Figure 23. *Bulbophyllum grotianum* J.J. Verm. (133) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, above: adaxial side, below: abaxial side; g. Pollinia, above: single pair, below: two pairs. – All from *Hort. Leiden* 970530 (spirit sample).

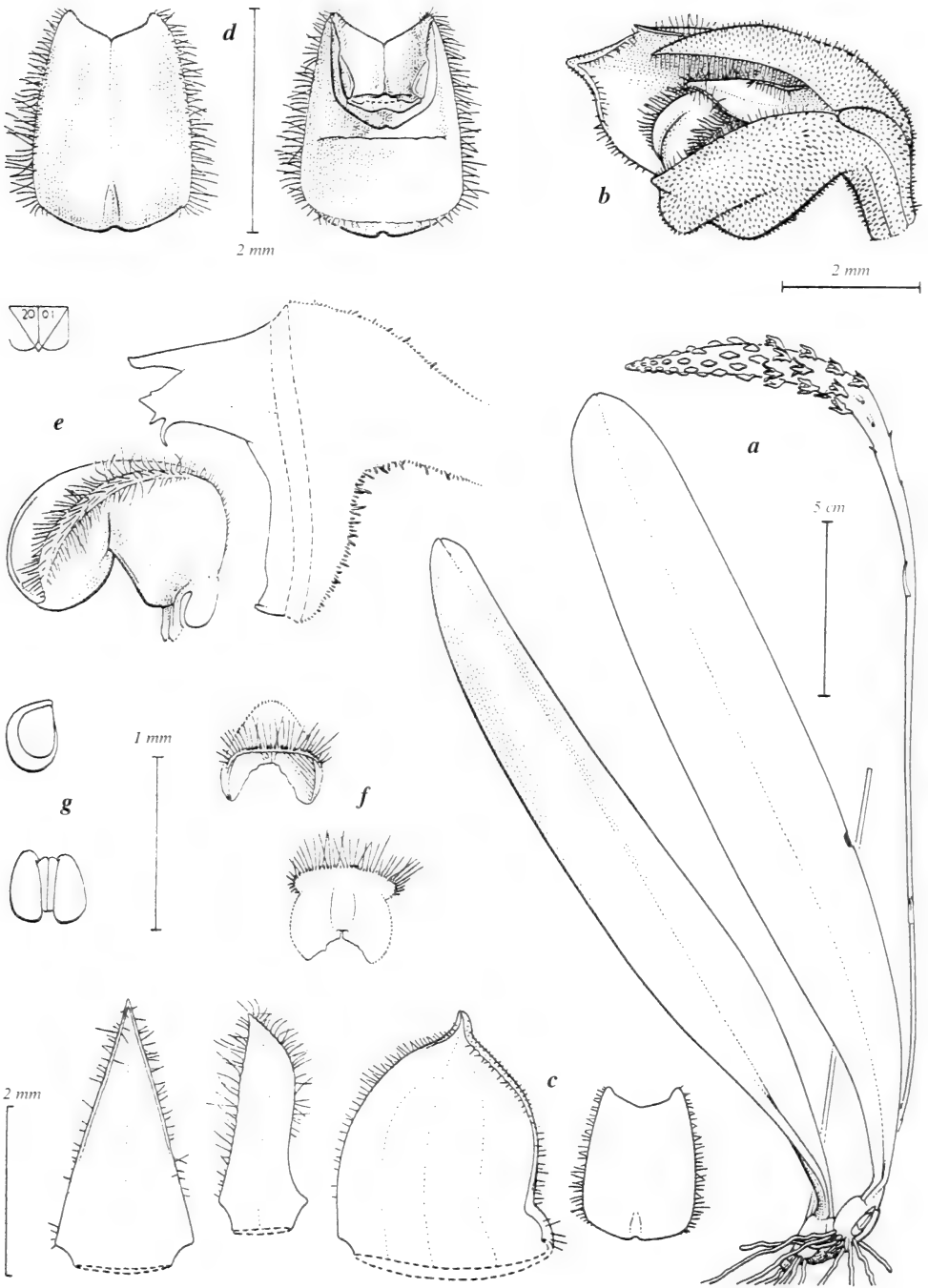


Figure 23. *Bulbophyllum grotianum* J.J. Verm. (133)

spotted maroon. Pollinia yellow.

Habitat & ecology: Epiphyte in forest on a steep limestone hill. Alt.: sea level to 250 m. Flowering in Jul—Sep in cultivation.

Distribution: MALAYSIA: Sarawak (1 specimen seen).

Notes: Differs from *Bulbophyllum atratum* and *B. groeneveldtii* in having an erect inflorescence with a nodding, much thicker rhachis. Named in honour of the late Mr. P.S.J. Groot, Borculo, the Netherlands, an avid orchid grower and friend of thirty years.

134. *Bulbophyllum janus* J.J. Verm., *nom. nov.* – Fig. 24. (*probably extinct*)

Bulbophyllum janus J.J. Verm. – Basionym: *Bulbophyllum platyrrhachis* Ridl., J. Fed. Malay States Mus. 8 (1917) 96. – SYNTYPES: Indonesia, Sumatra, Kerinchi, Siolak Daras, *Robinson & Boden Kloss s.n.* (BM, lecto.); Sumatra, central part, Sarik, Alahan Panjang, *Micholitz s.n.* (K).

[Not *Bulbophyllum platyrhachis* (Rolfe) Schltr, Bot. Jahrb. Syst. 38 (1905) 15 (= *B. maximum* [Lindl.] Rchb.f.).]

[Not *Bulbophyllum platirhachis* De Wild., Miss. Laur. (1906) 223 (= *B. acutebracteatum* De Wild. var. *acutebracteatum*).]

Rhizome c. 5 mm diam., sections between pseudobulbs 1—1.2 cm long. *Pseudobulbs* ?close, ovoid, 2.2—3 x 1.4—1.8 cm. *Petiole* 6—7.5 cm. *Leaf blade* elliptic to ovate, 16—19 x 4.8—5.5 cm, index (length/width) 3.3—3.5, rounded. *Inflorescence* an elongated, lax raceme, c. 65 cm, c. 100-flowered. *Peduncle* erect, c. 52 cm, bracts c. 5, the longest 23—25 mm long. *Rhachis* nodding, swollen and flattened, elliptic-ovate, c. 12.5 x 1.1 cm, densely papillose, top c. 3 cm with minute, sterile bracts only. *Floral bracts* triangular, 2—2.5 x c. 2 mm, acute. *Flowers* not much opening. *Pedicel* and *ovary* c. 4.5 mm long, with scattered coarse papillae, basal node on a 0.2—0.3 mm-long stump. *Median sepal* porrect, subtriangular, c. 4.3 x 2 mm, index 2.1—2.2; acute, margins shortly ciliolate towards the tip, base broadly attached; rather thick, surface adaxially glabrous but very finely pubescent near the tip, abaxially with scattered, coarse papillae. *Lateral sepals* slightly recurved, ovate, c. 4.3 x 3.8 mm, index 1.1—1.2; subacute, otherwise as the median sepal. *Petals* porrect, falcate, spathulate, c. 3.4 x 1.2 mm, index 2.8—2.9; truncate, margins ciliate, base broadly attached; rather thin; surface glabrous but adaxially hirsute near the tip. *Lip* rather abruptly recurved c. half-way, oblong, c. 3 x 1.9 mm, index 1.5—1.6; rounded, margins ciliate with the longest hairs about half-way up the lip; very thick; adaxially concave

Figure 24. *Bulbophyllum janus* J.J. Verm. (134) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: abaxial side, right: adaxial side; e. Column and lip, lateral view. – a (plant)—e. From *Robinson & Boden Kloss s.n.*; a (inflorescence). From *Micholitz s.n.* (all herbarium specimens).

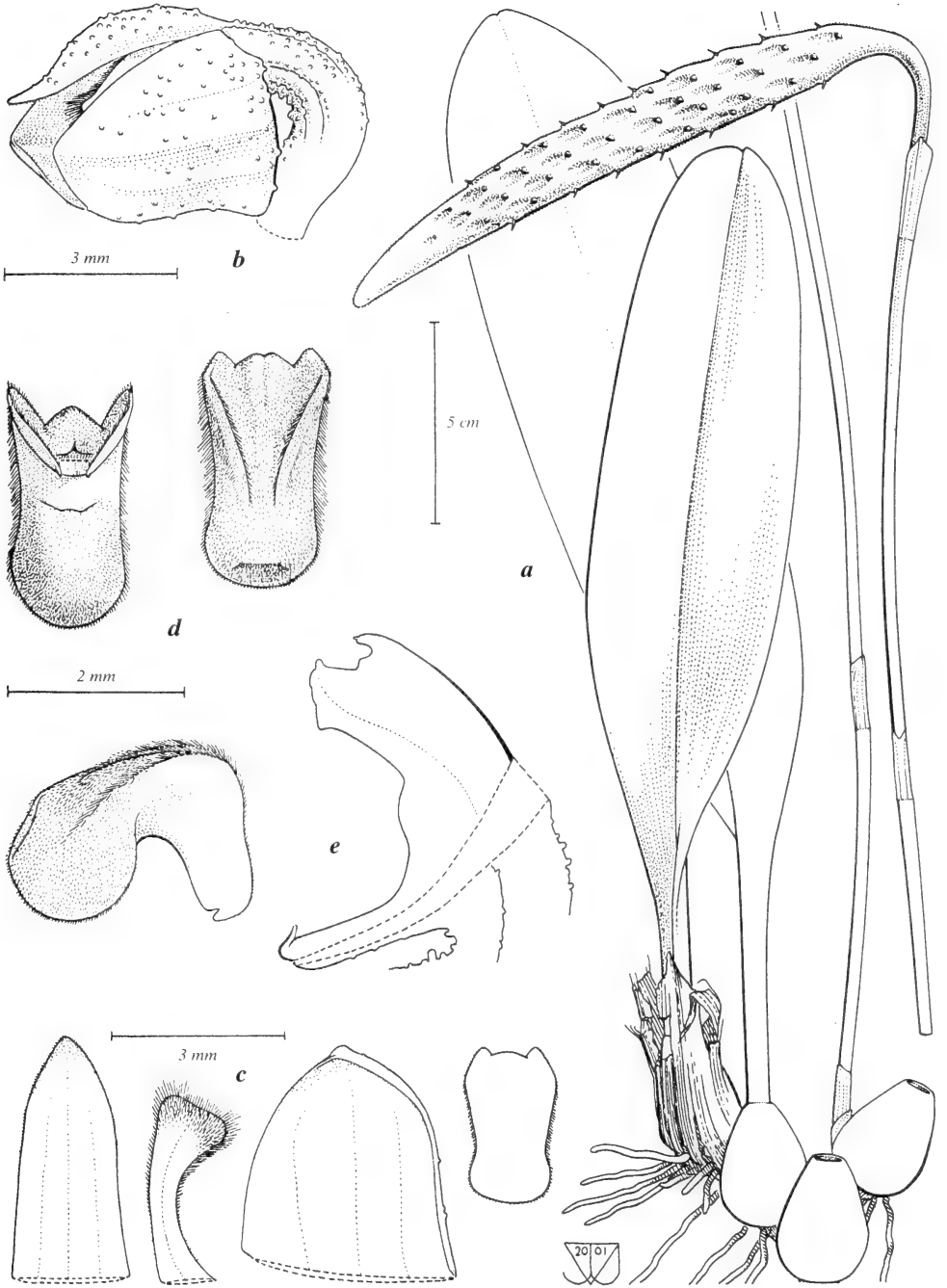


Figure 24. *Bulbophyllum janus* J.J. Verm. (134)

and with a basal callus continuing up to c. half-way up the lip and with a short median slit near the base, with 2 distinct, rounded ridges diverging proximally and continuing over c. 2/3 of the length of the lip, adaxial surface finely hirsute; abaxially with a wide, rounded ridge towards the base, convex towards the tip, surface glabrous towards the base and finely hirsute towards the tip. *Column* c. 2.3 mm long, stigma with a retuse callus at its base, column foot abaxially without a spur near the tip. *Stelidia* \pm triangular, c. 0.6 mm long, obtuse, with a small, antrorse, obtuse tooth along the upper margin, and a larger, triangular tooth along the lower margin, near the base.

Colours: Rhachis greenish. Flowers yellow.

Habitat & ecology: Alt. 600–1000 m. Flowering observed in Mar.

Distribution: INDONESIA: Sumatra (2 specimen seen). Not collected since 1914.

Notes: The name *platyrrhachis* is sufficiently close to *platyrhachis* and *platirhachis* to warrant a new name, following ICBN 2000, art. 53.3.

The material available does not allow detailed description of the development of the inflorescence during anthesis. According to the original description the rhachis is 5 cm wide. The only rhachis available (*Micholitz s.n.*, syntype) is, dry, 1.1 cm wide. Allowing for shrivelling, the reconstructed width would be c. 1.5 cm, as drawn in fig. 24. The width given in the original description is probably a typographical error.

The name refers to the two-sided rhachis.

135. *Bulbophyllum xiphion* J.J. Verm. – Fig. 25, plate 18, 19.

Bulbophyllum xiphion J.J. Verm., *Blumea* 41 (1996) 354. – TYPE: Indonesia, Kalimantan Timur, Apo Kayan, Gunung Sungei Pandan area, *Hort. Leiden* 913241 (L, holo.).

Rhizome 5–6 mm diam., sections between pseudobulbs 0.9–1.5 cm long. *Pseudobulbs* (almost) touching, ovoid, 1–1.6 x 1–1.6 cm. *Petiole* 4–6 cm. *Leaf blade* elliptic to obovate, 20–24 x 5–6.5 cm, index (length/width) 3.5–4; rounded to obtuse. *Inflorescence* an elongated, lax raceme, c. 42 cm, 60–70-flowered. *Peduncle* patent, c. 28 cm, bracts c. 4, the longest c. 16 mm long. *Rhachis* nodding, swollen and flattened, elliptic-ovate, 11–15 x 1.2–1.5 x 0.6–0.8 cm, finely rugose-papillose, top 3.5 cm with minute, sterile bracts only. *Floral bracts* deltoid to triangular, 0.5–1.2 x 0.9–1.2

Figure 25. *Bulbophyllum xiphion* J.J. Verm. (135) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Column and lip, lateral view; f. Anther, left: adaxial side, right: abaxial side; g. Pollinia, above: two pairs, below: single pair. – All from *Hort. Leiden* 913241 (spirit sample).

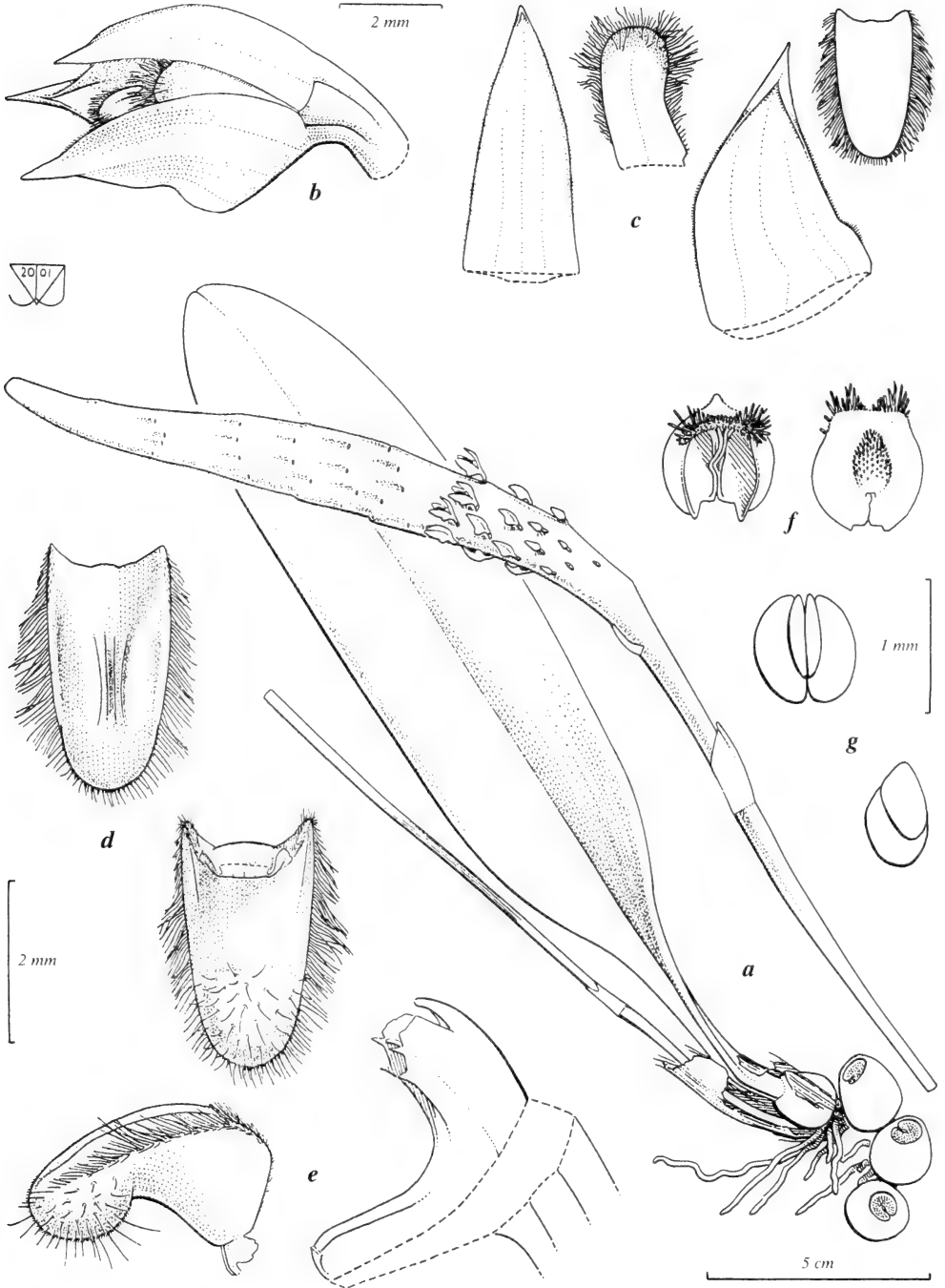


Figure 25. *Bulbophyllum xiphion* J.J. Verm. (135)

mm. acute. *Flowers* not much opening, a few simultaneously, anthesis from the top of the rhachis downwards. *Pedicel* and *ovary* 2—2.4 mm long, basal node \pm flush with the surface of the rhachis. *Median sepal* porrect, triangular, 5—5.5 x 2—2.4 mm, index 2.3—2.5; acute, margins shortly ciliate, base broadly attached; thick, surface adaxially very finely papillose towards the margins, abaxially glabrous. *Lateral sepals* slightly recurved, slightly falcate, 5.5—6.2 x 3.2—3.5 mm, index 1.7—1.8; acuminate, adaxially glabrous, otherwise as the median sepal. *Petals* porrect, obovate to elliptic, 3—3.2 x c. 1.5 mm, index 2—2.2; rounded, margins long ciliate except near the base, base broadly attached; thin, adaxially very finely papillose and with some long hairs towards the tip, abaxially glabrous. *Lip* rather abruptly recurved c. half-way, ovate, c. 3 x 1.7 mm, index 1.4—1.5; rounded, margins long ciliate with the longest hairs about half-way up the lip; very thick; adaxially somewhat concave near the base, with 2 inconspicuous, rounded ridges diverging proximally and continuing over c. 2/3 of the length of the lip, adaxial surface glabrous but very finely papillose towards the tip; abaxially with a wide, truncate ridge towards the base, convex towards the tip, surface glabrous but with scattered hairs implanted in tiny pits towards the tip. *Column* 2—2.2 mm long, column foot abaxially without a spur near the tip. *Stelidia* c. 0.6 mm long, acute, \pm rectangular in outline with an antrorse, truncate wing along the upper margin, and a small, narrowly triangular, acute tooth along the lower margin. *Anther*: front margin papillose with elongated papillae, abaxial ridge papillose.

Colours: Rhachis yellowish green, either spotted with bronze purple or not. Sepals off-white, adaxially spotted with purple. Lip purple.

Habitat & ecology: Epiphyte in primary forest on a ridge and on a tree overhanging a river. Alt. 650—1050 m. Flowering observed in Oct.

Distribution: INDONESIA: Kalimantan Timur (2 specimen seen).

136. *Bulbophyllum mirabile* Hallier – Fig. 26, 27, plate 20, 21.

Bulbophyllum mirabile Hallier., Ann. Jard. Bot. Buitenzorg 13 (1896) 316. – TYPE: West Kalimantan, Hort. Bogor (*Leg. Jaheri*) (BO, holo., not seen).

Pseudobulbs touching, ovoid-conical, 2.5—3 x 1.5—2 cm. *Petiole* 3—5 cm. *Leaf blade* elliptic, 19—20 x 7.4—8.5 cm, index (length/width) 2.3—2.6; rounded. *Inflorescence* an elongated, lax raceme, entirely pendulous, 11.3—29 cm, 75—120-flowered. *Peduncle* 2—9 cm, bracts 2—3, the longest

Figure 26. *Bulbophyllum mirabile* Hallier. (136) – a. Habit; b. Flowers, above: from the basal part of the rhachis, below: from the top part of the rhachis; c. Flower analysis, flower from the basal part of the rhachis, from left to right: median sepal, petal, lateral sepal, lip; d. Flower analysis, flower from the top part of the rhachis, from left to right: median sepal, petal, lateral sepal, lip. – All from *Jongejan cult. 4031* (spirit sample).

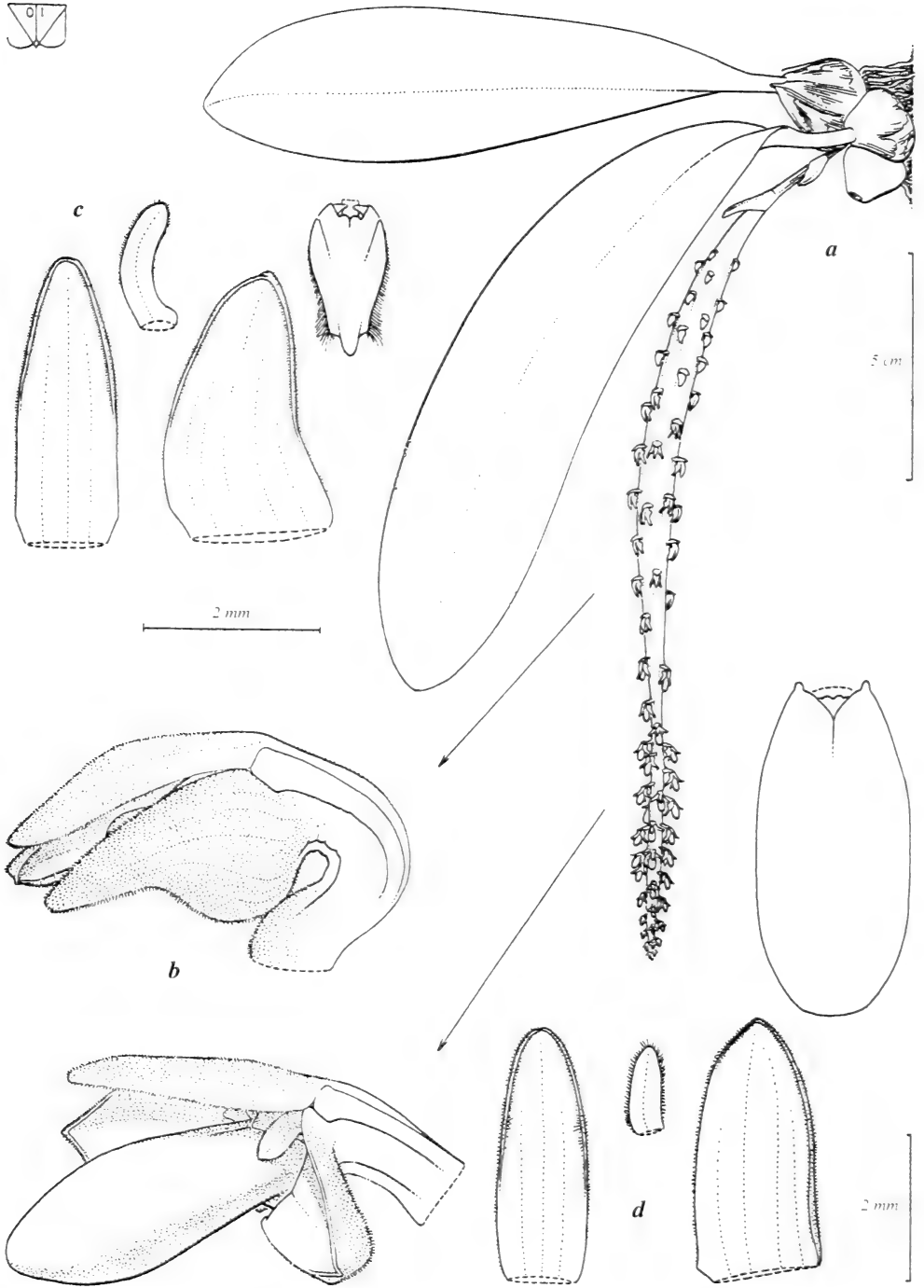


Figure 26. *Bulbophyllum mirabile* Hallier. (136)

11–13 mm long. *Rhachis* slightly papillose, basal part spindle-shaped, 4–10.5 x 0.7–0.8 cm, gradually tapering into a cylindrical top part of 4.3–14 x 0.3–0.45 cm. *Floral bracts* ovate to triangular, 2–2.5 x 12–2 mm, (sub)acute. *Flowers* many open simultaneously, dimorphic, flowers along the basal part of the rhachis different from those along the top part, anthesis starting at the transition between the two types, continuing upwards and downwards. *Flowers along the basal part of the rhachis* not much opening. *Pedicel* and *ovary* 2–3 mm long, locally papillose-hirsute, basal node \pm flush with the surface of the rhachis. *Median sepal* \pm porrect, ovate, 3–5 x 1.1–1.8 mm, index 2.3–3.4; obtuse, margins ciliolate, base rather broadly attached; rather thick, surface adaxially glabrous, abaxially papillose-hirsute. *Lateral sepals* slightly recurved, slightly falcate, 2.7–5 x 2–3 mm, index 1.2–1.7; otherwise as the median sepal. *Petals* porrect, falcate, elliptic to ovate, 1.3–3.5 x 0.3–0.9 mm, index 3.2–5; obtuse, margins ciliate, base broadly attached; rather thick with a very thick top, surface glabrous, adaxially sometimes hirsute towards the tip. *Lip* (rather abruptly) recurved c. half-way, ovate, 1.8–2.3 x 0.9–1.3 mm, index 1.7–2; rounded, margins ciliate with the cilia longest near the tip; very thick; adaxially concave and with 1–2 basal calli sometimes continuing up to c. half-way up the lip and with a short median slit near the base, with two distinct ridges diverging proximally, continuing over 1/2–4/5 of the lip and distally fused to a wide, rounded or flat median ridge overtopping the tip of the lip, adaxial surface glabrous, distally sometimes verrucose along the median line; abaxially with a wide, rounded to truncate, glabrous to papillose ridge towards the base, convex and hairy towards the tip; basal auricles sometimes inconspicuous. *Column* 1.1–1.8 mm long, stigma with two small, obtuse lateral teeth near its base, column foot abaxially without a spur near the tip. *Stelidia* 0.4–0.5 mm long, acute, \pm rectangular in outline with an antrorse, deltoid, obtuse to acute tooth along their upper margin and a similar but often patent tooth along their lower margin. *Anther*: front margin ciliate, abaxial ridge \pm glabrous. *Flowers along the top part of the rhachis* similar, but opening wide. *Pedicel* and *ovary* 0.5–1.5 mm long. *Median sepal* somewhat recurved, 3.3–4.2 x 1.2–1.3 mm, index 2.5–3.5. *Lateral sepals* spreading, 3.4–4.8 x 1.8–2.2 mm, index 1.8–2.2; otherwise as the median sepal. *Petals* 1.3–2.2 x c. 0.5 mm, index 2.6–4.4. *Lip* recurved near the base, elliptic, 3–4.2 x 1.5–2 mm, index 2.1–2.5; margins ciliolate near

Figure 27. *Bulbophyllum mirabile* Hallier, (136) – Flower from the basal part of the rhachis: a. Lip, left: adaxial side, right: abaxial side; b. Lip, adaxial side; c. Column and lip, lateral view; d. Anther, left: adaxial side, right: abaxial side; e. Pollinia, left: single pair, right: two pairs. – Flower from the top part of the rhachis: f. Lip, left: adaxial side, right: abaxial side; g. Column and lip, lateral view. – b. From *Bogor comm.* 153; a, c–g. From *Jongejan cult.* 4031 (both spirit samples).

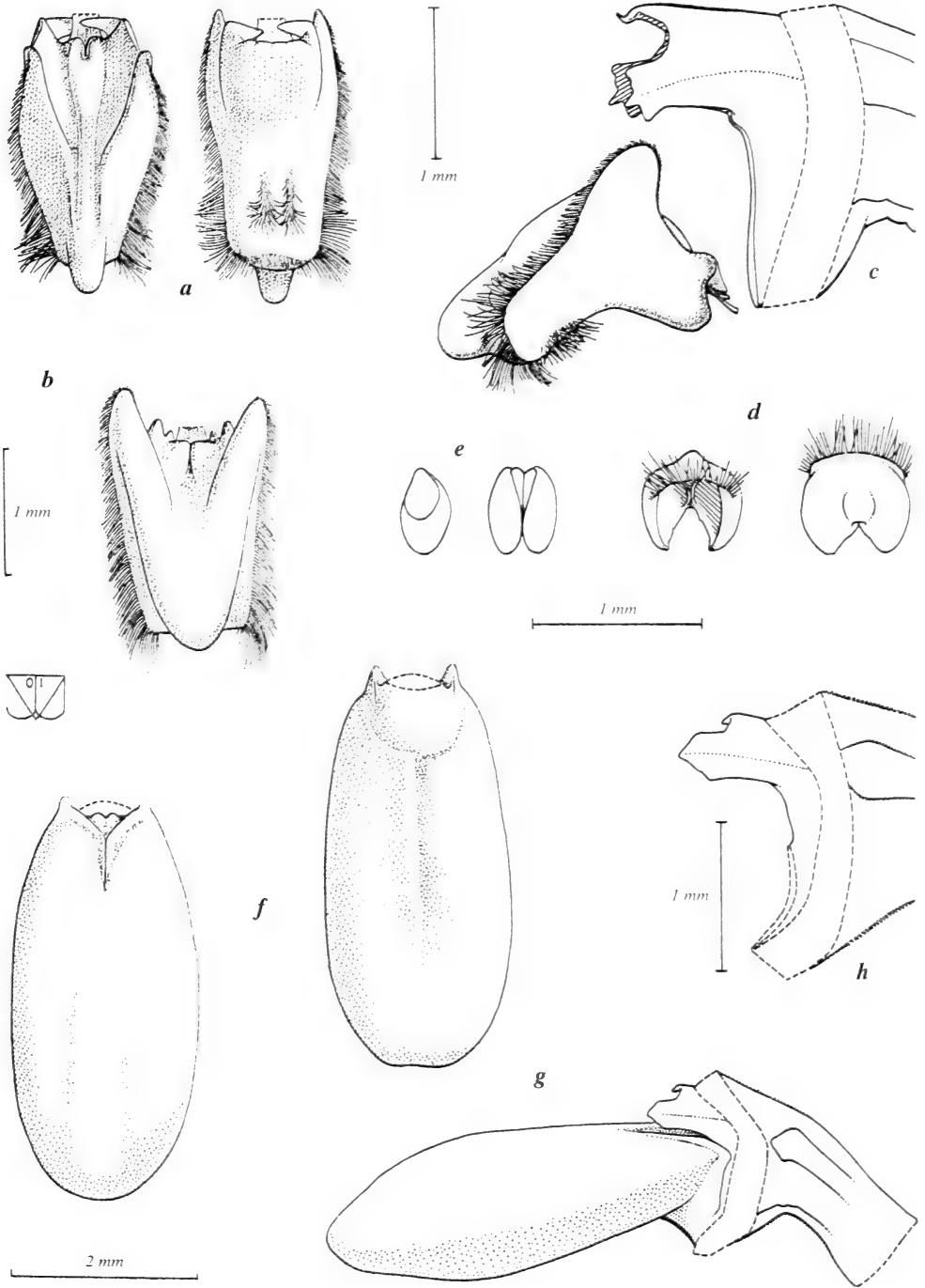


Figure 27. *Bulbophyllum mirabile* Hallier. (136)

the base, elsewhere glabrous to sparsely ciliate, surface glabrous; adaxially slightly concave and with two calli near the base, convex beyond two short ridges together forming a 'v'; abaxially with a rounded ridge near the base, convex towards the tip.

Colours: Rhachis and sepals pale greenish with pale purple dots. Petals translucent whitish or yellowish, with purple dots and cilia. Lip whitish, adaxially suffused with reddish purple, hairs purple.

Habitat & ecology: Epiphyte. Alt. 200—300 m.

Distribution: MALAYSIA: Peninsula (1 specimen seen, a doubtful record, see below). BRUNEI (1). INDONESIA: Kalimantan (1).

Notes: The only *Bulbophyllum* with dimorphic flowers. The two forms occupy separate parts of the rhachis: a short transitional area carries a few flowers of intermediate shape. The flowers along the basal part of the rhachis seem to be fertile: those along the top part often (not always) have a malformed and incomplete column with neither pollinia nor stigma. In such flowers, the lip and the petals may be immovably fused with the column. Near the tip of the rhachis the flowers gradually but conspicuously decrease in size.

The specimen *Hort. Glasnevin s.n.* is marked 'Malaya'. In the past, this was used for what is now Peninsular Malaysia, but the species has not been collected there since. The record is considered doubtful. In spite of having been in cultivation on three independent occasions, no vegetative parts have been preserved except for one leaf. Details have been copied from Hallier's original description.

137. *Bulbophyllum spadiceflorum* Tixier

Bulbophyllum spadiceflorum Tixier. *Adansonia* 6 (1966) 449. incl. **line drawing:** Tran Hop. Orch. Vietnam (1998) 126. **colour photograph 33.** — *Osyricera spadiceflora* (Tixier) Garay. Hamer & Siegerist. *Nordic J. Bot.* 14 (1994) 643. — **TYPE:** Vietnam, Quang Duc, piste de Fyan. *Hort. Paris* 174/65 (P. holo., not seen).

Rhizome c. 8 mm diam., sections between pseudobulbs 1.5—2 cm long. *Pseudobulbs* distant, ovoid, c. 1.2 x 1 cm. *Petiole* c. 2 cm. *Leaf blade* elliptic to obovate, c. 25 x 2.5—3 cm, index (length/width) 8.3—10; obtuse. *Inflorescence* an elongated, lax raceme, c. 50 cm. *Peduncle* erect to patent, c. 30 cm, bracts c. 5, the longest c. 20 mm long. *Rhachis* nodding, swollen, ± circular in section, c. 20 x 0.5—0.6 cm. *Floral bracts* c. 2 mm long, acuminate. *Flowers:* anthesis from the top of the rhachis downwards. *Median sepal* porrect, triangular, c. 4 x 0.8 mm, index c. 5, margins ciliate. *Lateral sepals* c. 4 x 2 mm, index c. 2; acuminate. *Petals* porrect, obovate, c. 1.6 x 0.6 mm, index c. 2.7; rounded, margins ciliate except near the base, base rather narrowly attached. *Lip* recurved in the proximal half, obovate, c. 3.5 mm

long, rounded, margins with long hairs towards the tip; adaxially somewhat concave near the base, without a median ridge, surface papillose; abaxial surface glabrous. *Column* c. 1.7 mm long, column foot abaxially without a spur near the tip. *Stelidia* obtuse. *Anther*: front margin ciliate, abaxially papillose.

Colours: Rhachis green. Sepals and petals yellowish green with purple veins. Lip purple.

Habitat & ecology: Alt. 500—1000 m. Flowering observed in May.

Distribution: VIETNAM: Central part.

Notes: No material available, although the species has been found again recently (Tran Hop, 1998). The type could not be found in P. The information above has been compiled from Tixier's description and illustration.

138. *Bulbophyllum polycyclum* J.J. Verm. – Fig. 28, plate 22.

Bulbophyllum polycyclum J.J. Verm., *Blumea* 41 (1996) 351. – TYPE: Indonesia, Kalimantan Timur, Apo Kayan, Gunung Sungei Pandan area. *Hort. Leiden* 913457 (L, holo.).

Rhizome 3—4 mm diam., sections between pseudobulbs 0.9—1.2 cm long. *Pseudobulbs* touching, ovoid to depressed-conical, 1.2—1.5 x 1.3—1.8 cm. *Petiole* 3—4 cm. *Leaf blade* elliptic to ovate, 12.5—16 x 4.5—6.5 cm, index (length/width) 2.2—2.4; obtuse. *Inflorescence* an elongated, rather lax raceme with the flowers spirally arranged towards the base of the inflorescence, arranged in often imperfect whorls of 5—8 or in interrupted spirals towards the tip, entirely pendulous, 50—75 cm, 70—90-flowered. *Peduncle* 17—40 cm, bracts 5—6, the longest 8—10 mm long. *Rhachis* swollen, ± circular in section, with the flowers on low-conical protuberances, 33—36 x 0.3—0.4 cm, ± glabrous. *Floral bracts* triangular, 1.2—1.5 x 1—1.3 mm, acute. *Flowers* not much opening, a few simultaneously. *Pedicel* and *ovary* 2.2—3 mm long, basal node on a c. 0.5 mm-long stump. *Median sepal* ± porrect, triangular, 3.6—4.5 x 1.5—2 mm, index 1.9—2.7; obtuse, margins very finely papillose, base rather narrowly attached; rather thick, surface adaxially glabrous, abaxially very finely papillose-hirsute. *Lateral sepals* slightly recurved, 3.3—4 x 2.5—3 mm, index 1.2—1.6; otherwise as the median sepal. *Petals* porrect, ovate to spatulate, with a widened base, 1.9—2 x 0.6—1 mm, index 2—3.2; rounded, margins ciliate, base rather broadly attached; thin, surface glabrous. *Lip* abruptly recurved slightly over half-way, elliptic-obovate, 2.2—2.9 x 1.5—1.8 mm, index 1.5—2, rounded; margins ciliate with the cilia longest c. half-way up the lip; very thick, surface ± glabrous; adaxially concave and with two weak calli continuing to half-way up the lip as weak ridges near the base, with a

median slit over most of its length ending in a small, circular plug that can be removed and leaving a deep conical pit, with two distinct ridges diverging proximally and continuing over c. 1/2 of the lip, surface distally distinctly convex and overtopping the front margin; abaxially with a wide, truncate ridge towards the base, convex towards the tip. *Column* 1.8—2 mm long, stigma with 2 large lateral calli at its base, column foot swollen, abaxially without a spur near the tip. *Stelidia* falcate, triangular, c. 0.7 mm long, acute, with an antrorse, deltoid, obtuse tooth along their upper margin and a similar but triangular, acute tooth along their lower margin. *Anther*: front margin ciliate, abaxial ridge glabrous.

Colours: Rhachis dark green. Sepals and petals greenish, heavily stained with blackish purple, particularly towards the margins and near the veins. Lip yellowish, stained with blackish purple.

Habitat & ecology: Epiphyte in *kerangas* forest of c. 20 m high, with a mossy floor. Alt. 850—1700 m.

Distribution: MALAYSIA: Sabah (1 specimen seen). INDONESIA: Kalimantan (1).

139. *Bulbophyllum lindleyanum* Griff. – Fig. 29, plate 23.

Bulbophyllum (“*Bolbophyllum*”) *lindleyanum* Griff., Notulae 3 (1851) 287. – *Phyllorchis lindleyana* (Griff.) O. Kuntze, Rev. Gen. Pl. 2 (1891) 677. — TYPE: Myanmar, Mergui, Griffith 697 (not seen).

Bulbophyllum rigens Rchb.f., Hamburger Garten- Blumenzeitung 21 (1865) 296. – *Phyllorchis rigens* (Griff.) O. Kuntze, Rev. Gen. Pl. 2 (1891) 677. — TYPE: locality unknown, *Herb. Reichenbach* 2252 (*Day* 63) (W, holo.).

Bulbophyllum caesariatum Ridl., Bull. Misc. Inform., Kew (1924) 202. – SYNTYPES: Thailand, southwest coast, Kopah Jan-Jan, Haniff & Nur SFN 2702 (SING, lecto.; K, isolecto., the latter not seen); 2750 (K, not seen).

Rhizome 2.5—3.5 mm diam., sections between pseudobulbs 1.2—2.5 cm long. *Pseudobulbs* touching, ovoid to globose, 1.2—3 x 1—2.5 cm. *Petiole* 1.8—3.5 cm. *Leaf blade* elliptic to ovate, 6—18 x 1.5—3 cm, index (length/width) 4—6.8; acute. *Inflorescence* an elongated, rather lax raceme, 11—28 cm, 9—25-flowered. *Peduncle* erect to patent, 6—19 cm, bracts c. 6, the longest 4.8—13 mm long. *Rhachis* nodding, not thickened, 3.5—10 cm, hispid with short, stiff hairs. *Floral bracts* triangular, 5—8 x 1.2—2.5 mm, acuminate. *Flowers* opening fully, many simultaneously. *Pedicel* and *ovary* 7—11 mm long, hispid as the rhachis, basal node on a 0.3—1 mm-long

Figure 28. *Bulbophyllum polycyclum* J.J. Verm. (138) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, adaxial side; e. Lip, abaxial side; f. Column and lip, lateral view; g. Anther, above: abaxial side, below: adaxial side; h. Pollinia, above: single pair, below: two pairs. – All from *Hort. Leiden* 913457 (spirit sample).

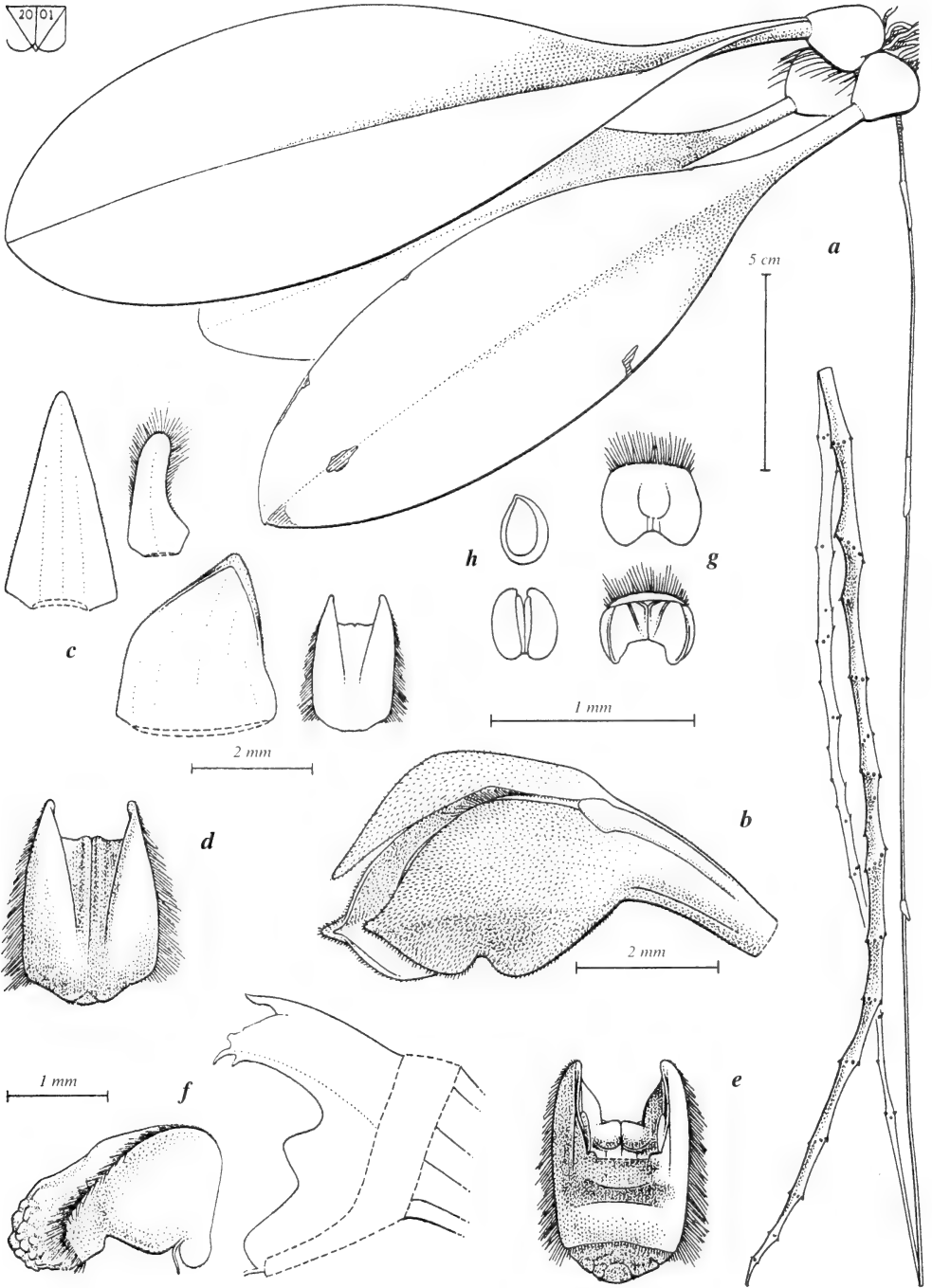


Figure 28. *Bulbophyllum polycyclum* J.J. Verm. (138)

stump. *Median sepal* recurved, ovate, 5.1—6.5 x 2.2—3.5 mm, index 1.7—2.5; acute to acuminate, margins somewhat papillose, sparsely ciliate, base broadly attached; rather thin, surface locally very finely papillose, adaxially pilose with long, thin hairs, abaxially hispid as the rhachis. *Lateral sepals* ovate-triangular, 6—8 x 3—4 mm, index 1.5—2; acuminate, upper margin without cilia; otherwise as the median sepal. *Petals* somewhat recurved, elliptic to ovate, 1.5—2.3 x 1.2—1.5 mm, index 1.1—2; (sub-)acute, margins ciliate, base broadly attached; thin; surface glabrous but abaxially pilose near the tip. *Lip* abruptly recurved slightly below half-way, ovate-oblong, 2—3 x 1.2—1.8 mm, index 1.3—2.1 (all without artificial spreading); rounded, margins ciliate in the distal 2/3; rather thin, surface \pm glabrous; adaxially almost flat proximally, somewhat convex distally; abaxially with a weak, rounded ridge proximally, slightly convex distally; basal auricles absent or inconspicuous. *Column* 2.5—3 mm long, foot slightly swollen. *Stelidia* subulate, 1—1.7 mm long, subacute, finely papillose distally, near the base with a minute, obtuse tooth along their upper margin, and a distinct, deltoid, rounded to obtuse wing along their lower margin. *Anther*: front margin and abaxial side papillose.

Colours: Sepals and petals greenish yellow to white, the sepals with blackish purple to dark brown veins and sometimes a similarly coloured tip, the petals with a similarly coloured or a greenish vein. Lip greenish yellow with greyish hairs.

Habitat & ecology: In forest, also found as an epiphyte in old rubber plantations among limestone hills. A lowland species. Flowering observed in Jan, Nov, Dec.

Distribution: MYANMAR: Moulmein (2 specimens seen); Mergui (*vide* Griffith); 'S part, close to Thai border' (1). THAILAND: Peninsula (6).

Notes: Two sheets: *Herb. Reichenbach (Foerstermann) 15563*, and *Foerstermann 08* (both W) are marked "Sarawak". On the first sheet another locality: "Birma, Bhamo" is also given but crossed out. Foerstermann has collected both in Myanmar (Burma) as well as in Sarawak, nevertheless I assume that both sheets are wrongly labeled because the species has never been found again in Sarawak, and the locality is far outside its known range.

Figure 29. *Bulbophyllum lindleyanum* Griff.(139) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, adaxial side; e. Lip, abaxial side; f. Column and lip, lateral view; g. Anther, left: adaxial side, right: abaxial side; h. Pollinia, above: two pairs, below: single pair. – All from FF 48 (spirit sample).

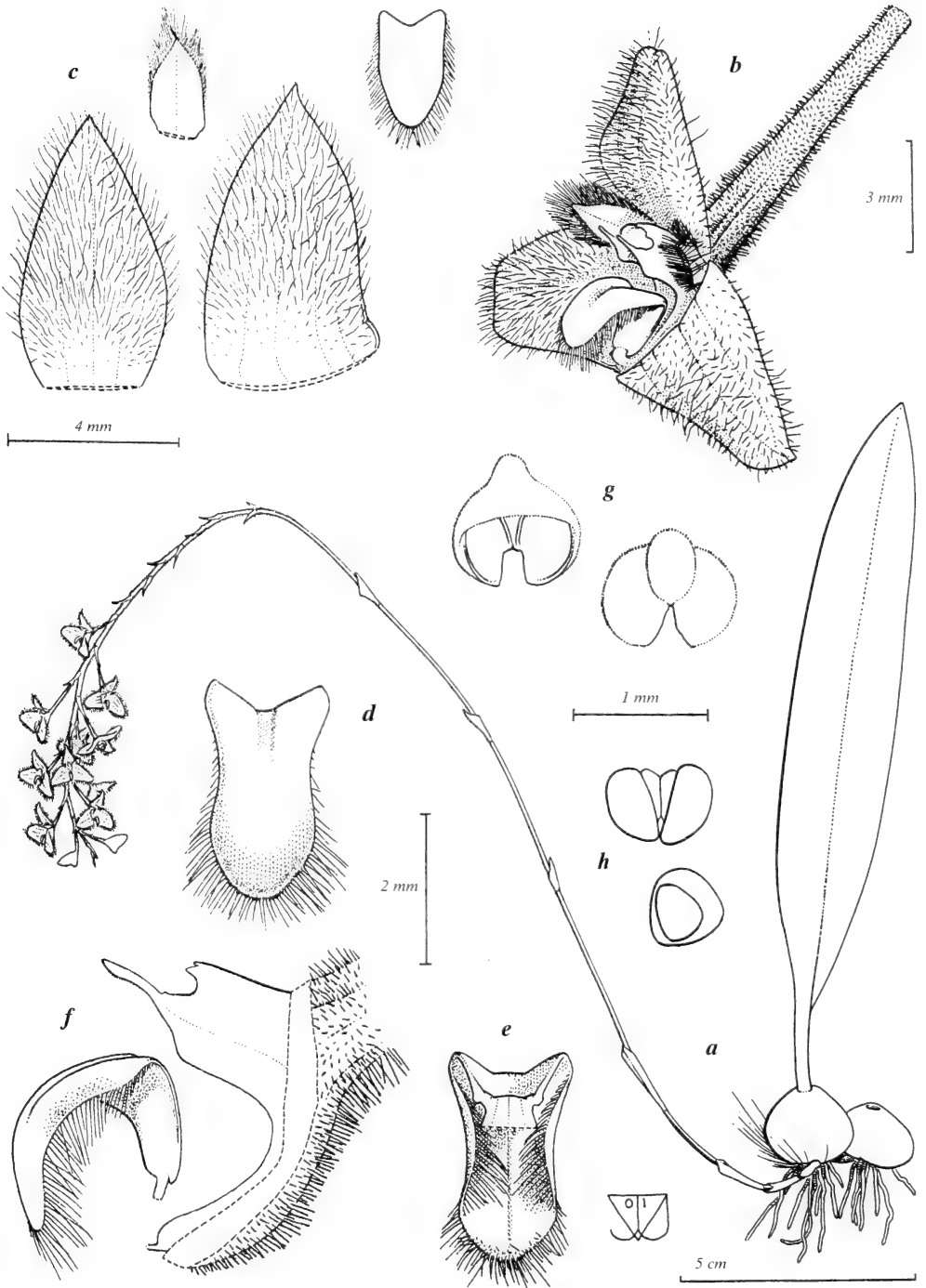


Figure 29. *Bulbophyllum lindleyanum* Griff. (139)

140. *Bulbophyllum tremulum* Wight – Fig. 30, plate 24.

Bulbophyllum (“*Bolbophyllum*”) *tremulum* Wight, Icon. Pl. Ind. or. 5, 1 (1851) t. 1749; Joseph, Rec. Bot. Surv. India 22 (1982) 92. – *Phyllorchis tremula* (Wight) O. Kuntze, Rev. Gen. Pl. 2 (1891) 678. — TYPE: India, Nilgiri Hills, *Jerdon s.n.* (not seen).

Rhizome 1.8—3.2 mm diam., sections between pseudobulbs 1.2—3 cm long. *Pseudobulbs* close or distant, ovoid or low-conical, 0.7—1.5 x 0.8—1.7 cm, surface somewhat corrugated. *Petiole* 0.1—0.7 cm. *Leaf blade* ovate, 2—8.5 x 0.6—1.6 cm, index (length/width) 2.7—4.3; obtuse. *Inflorescence* an elongated, lax raceme, 7—26 cm, 9—13-flowered. *Peduncle* erect to patent, 5—9 cm, bracts 3—4, the longest 4—8.5 mm long. *Rhachis* erect to arching, not thickened, 2—7 cm, glabrous. *Floral bracts* triangular, 1.2—3 x 0.7—1.2 mm, acute. *Flowers* ± distichous, secund, opening wide, many simultaneously. *Pedicel* and *ovary* 7—8 mm long, basal node on a 0.3—0.6 mm-long stump. *Median sepal* spreading to reflexed, triangular, 7—12 x 1.7—2.8 mm, index 3.7—5.5; acute, margins ciliate, base rather narrowly attached; thin, adaxial surface pubescent towards the base, abaxially glabrous. *Lateral sepals* 8—13.5 x 2—4.2 mm, index 2.6—4.5; upper margin sparsely ciliolate; otherwise as the median sepal. *Petals* porrect, elliptic-ovate with a wide base, 1.8—2.6 x 0.8—0.9 mm, index 2—2.9; obtuse to acute, margins ciliate, base broadly attached; thin, surface glabrous but pubescent adaxially near the tip. *Lip* recurved near the base, oblong, 5.5—8 x 1.7—2 mm, index 3.2—4.7; rounded to obtuse, margins ciliate proximally; lip thick, very thick near the base; adaxially somewhat concave and with two calli near the base, with two distinct ridges diverging proximally and continuing parallel and close together over c. 1/2 of the lip, adaxial surface smooth to distinctly verrucose, glabrous; abaxially with a rounded ridge near the base, surface otherwise ± flat, with numerous spindle-shaped hairs arising from tiny pits, surface otherwise glabrous. *Column* 1.5—2 mm long, stigma distinctly protruding at its base. *Stelidia* 0.5—0.7 mm long, obtuse, ± rectangular in outline with an antrorse, deltoid, obtuse tooth along the upper margin, and a deltoid, rounded to obtuse wing along the lower margin. *Anther*: front margin and abaxial ridge with distinct, elongated papillae.

Colours: Sepals and petals yellowish or greenish, veins and margins partially or entirely purple; the petals sometimes entirely suffused with

Figure 30. *Bulbophyllum tremulum* Wight. (140) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, above: abaxial side, below: adaxial side; g. Pollinia, above: single pair, below: two pairs. – All from *Jongejan cult. 4544* (spirit sample).

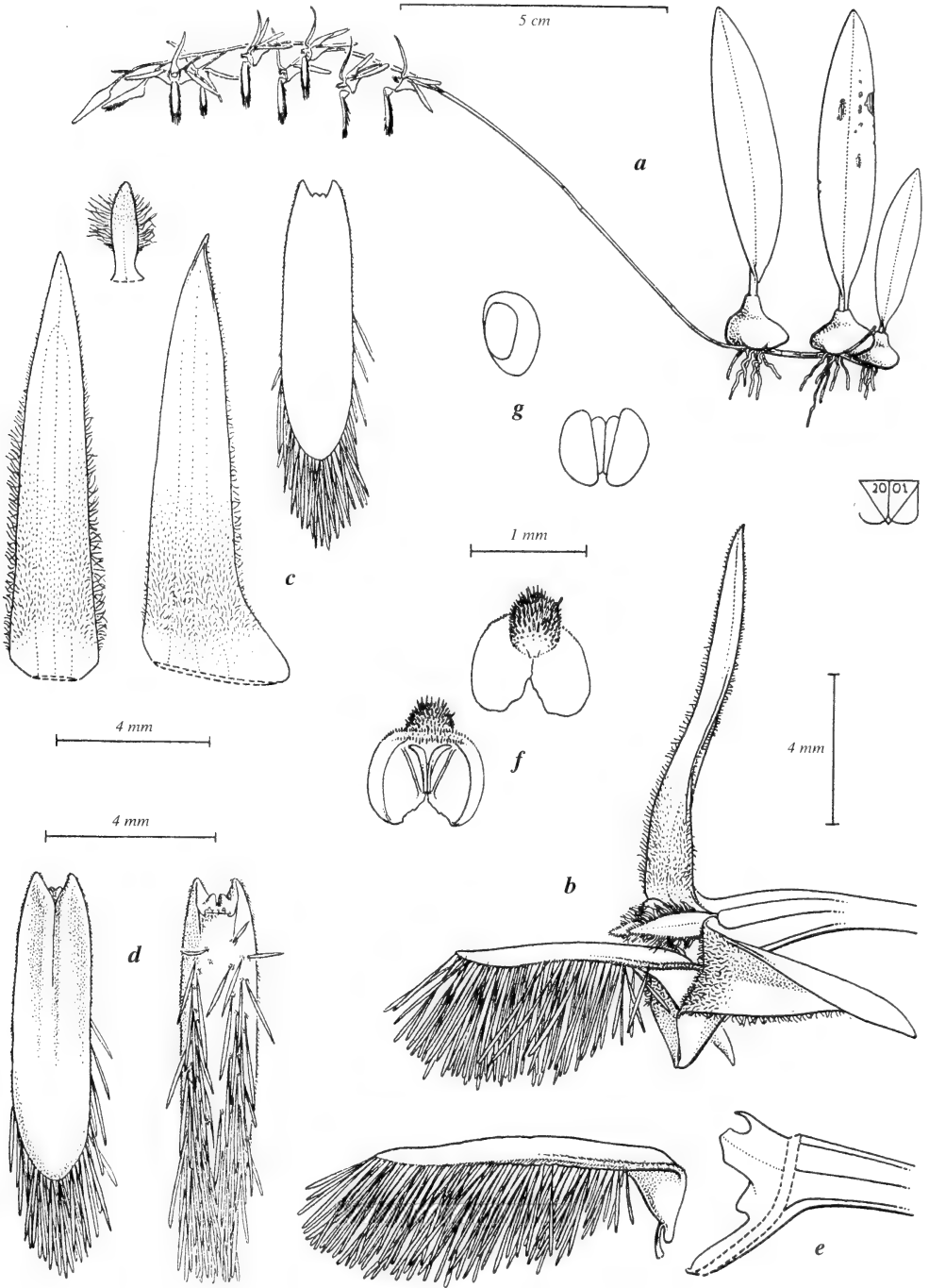


Figure 30. *Bulbophyllum tremulum* Wight (140)

purple. Lip white, yellow or brownish, sometimes suffused with purple near the base, or entirely dark purple. Hairs along the margins white, those on the abaxial side of the lip purple.

Habitat & ecology: Alt. 800—1100 m. Flowering in Jan, Feb, Sep, Dec (Feb, Apr in cultivation).

Distribution: INDIA: south-west part: Nilgiris, Silent Valley (4 specimens seen).

Notes: Data from Joseph (1982) have been included in the description.

141. *Bulbophyllum scaphiforme* J.J. Verm., *sp. nov.* – Fig. 31.

Bulbophyllum scaphiforme J.J. Verm., a *Bulbophyllo nigrescenti* labello marsupiiformi differt. – TYPE: Thailand, Doi San Yao, *Seidenfaden & Smitinand (GT) 7464* (C, holo.).

Bulbophyllum nigrescens sensu Seidenf. & Smitin., Orch. Thailand 3 (1961) 426 (partly, incl. fig. 319); Seidenf., Dansk Bot. Ark. 33, 3 (1979) 104 (partly, incl. fig. 64); Tran Hop, Orch. Vietnam (1998) 113, **colour photograph 30**; S.C. Chen *et al.*, Native Orch. China (1999) 35 (**upper left and right colour photographs only**), non Rolfe.

Rhizome: sections between pseudobulbs 1.5—2.5 cm long. *Pseudobulbs* close, depressed conical, 1.5—2.5 x 1.5—3 cm. *Petiole* 1—1.5 cm. *Leaf blade* ?elliptic, 7—9.2 x c. 1.8 cm, index (length/width) c. 3.9; ?subacute. *Inflorescence* an elongated, rather lax raceme, erect to patent, 28—54 cm, 23—33-flowered. *Peduncle* 14—25 cm. *Rhachis* not thickened, 14—22 cm long, glabrous. *Floral bracts* triangular, 3—4 x c. 2 mm, acute. *Flowers* spreading to reflexed, secund, not fully opening, many simultaneously. *Pedicel* and *ovary* 5.5—9 mm long, basal node on a 0.8—2 mm-long stump. *Median sepal* porrect to recurved, ovate, 4.5—7.5 x 2—4.2 mm, index 2.3—3.8; acute, margins ciliate, base rather broadly attached; rather thin, adaxially pubescent, abaxially glabrous. *Lateral sepals* recurved, elliptic to ovate, 6—8 x 2.5—4.2 mm, index 1.9—2.4; acute to acuminate, otherwise as the median sepal. *Petals* ± porrect, spatulate, 2—2.5 x 0.8—1.5 mm, index 1.6—2.5; acute to acuminate, margins ciliate distally, base broadly attached; rather thick with a thick top, surface pubescent distally. *Lip* recurved in the proximal half, pouch-shaped distally, obovate in outline, 4.8—5.5 x 1.8—3.2 mm, index 1.6—2.8; rounded, margins ciliate; rather thin; adaxially somewhat concave and with a median slit reaching up to c.

Figure 31. *Bulbophyllum scaphiforme* J.J. Verm. (141) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, left: adaxial side, right: abaxial side; g. Pollinia, above: a single pair, below: two pairs. – a (plant). Modified after Seidenfaden & Smitinand (1961); a (inflorescence). From *Tixier s.n.* (herbarium specimen); b—g. From *GT 7464* (spirit sample).

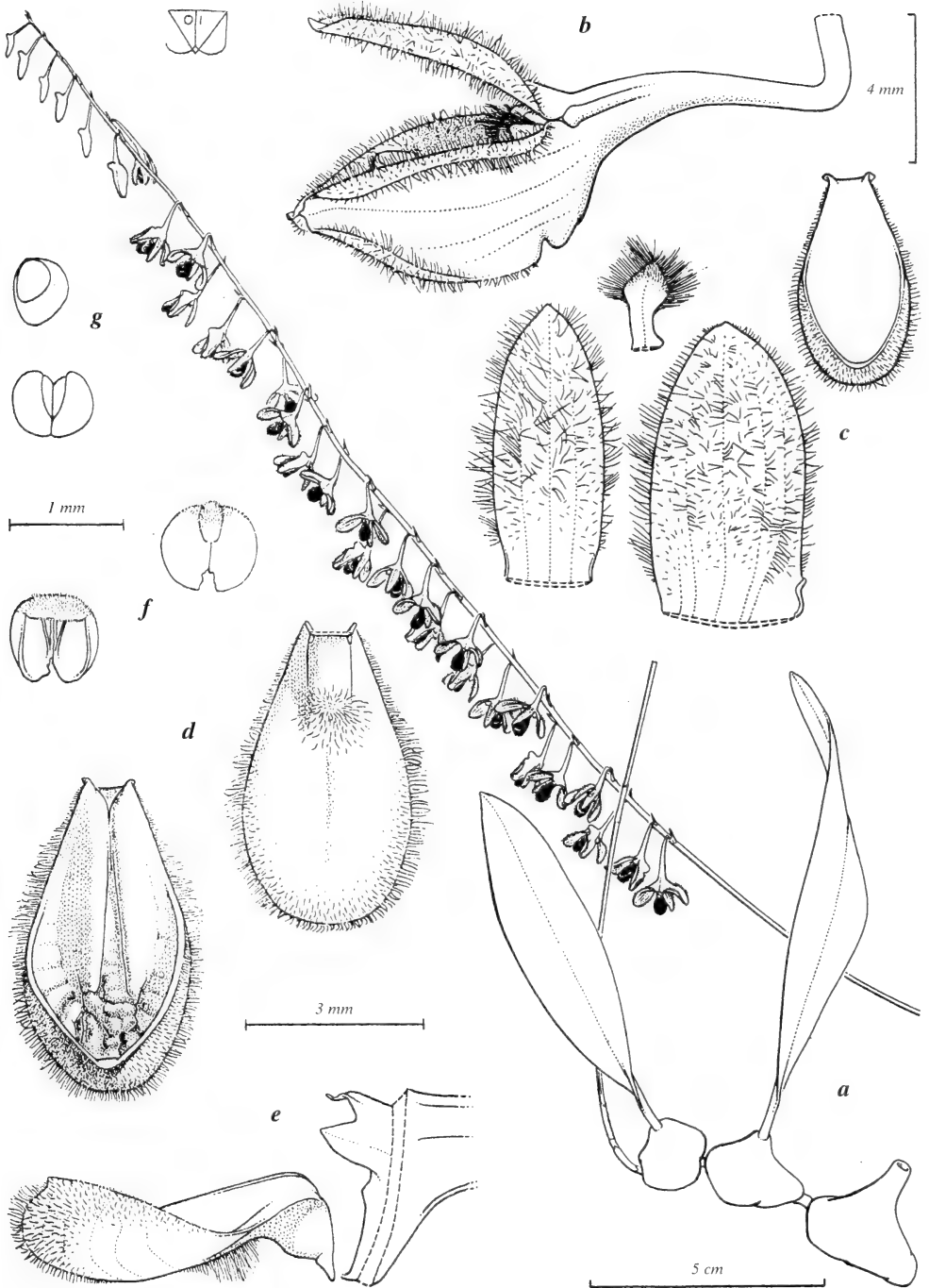


Figure 31. *Bulbophyllum scaphiforme* J.J. Verm. (141)

1/3 of the lip near the base, with 2 distinct, obtuse ridges diverging proximally, running \pm parallel over c. 3/4 of the lip, and ending in some irregularly shaped calli, surface with irregular, radiating furrows distally but otherwise glabrous; abaxially with a wide, rounded ridge near the base, surface otherwise convex, pubescent, or only so in front of the basal ridge and towards the margins. *Column* 1—1.6 mm long, stigma with a distinct, obtuse tooth slightly below its base. *Stelidia* triangular, 0.4—0.7 mm long, acute. *Anther*: front margin and abaxially towards the tip densely papillose.

Colours: Sepals blackish purple, yellowish towards the base, or yellowish with blackish purple veins, margins and scattered spots. Petals blackish purple distally, yellowish proximally, often with a blackish purple vein. Lip blackish purple with green or yellowish ridges adaxially. Anther yellow.

Habitat & ecology: Alt. 1100–1400 m. Flowering in Mar—May, Jul.

Distribution: CHINA: Yunnan (*vide* S.C. Chen *et al.*, under *B. nigrescens*). THAILAND (5 specimens seen). VIETNAM: southern part (1).

Notes: This species has been confused with *Bulbophyllum nigrescens* by Seidenfaden & Smitinand (1961), and Seidenfaden (1979). It is clearly distinct from this species in having a pouch-shaped (or boat-shaped) lip. The specific epithet refers to that character.

No vegetative parts are available, the description has been completed from Seidenfaden & Smitinand (1961, fig. 319, sub *B. nigrescens*).

142. *Bulbophyllum nigripetalum* Rolfe – Fig. 32, plate 25.

Bulbophyllum nigripetalum Rolfe, Bull. Misc. Inform., Kew (1891) 197; Summerh., Kew Bull. 6 (1952) 471. — SYNTYPES: “said to have been imported (...) from the West Coast of Africa”, later shown to originate from Asia by Summerhayes (1952), *O’Brien cult.* (1891) (K, lecto.), *O’Brien cult.* (1889) (K).

Bulbophyllum secundum sensu Seidenf., Dansk Bot. Ark. 33, 3 (1979) 103 (partly, incl. syn. *B. nigripetalum*), non Hook.f.

Bulbophyllum nigrescens sensu S.C. Chen *et al.*, Native Orch. China (1999) 35 (**lower left colour photograph only**), non Rolfe.

Rhizome 1.5—3 mm diam., sections between pseudobulbs 0.6—2.5 cm long. *Pseudobulbs* close, ovoid or low-conical, 0.9—1.7 x 0.9—1.8 cm. *Petiole* 0.8—2 cm. *Leaf blade* elliptic, 5.2—17 x 0.6—1.5 cm, index (length/

Figure 32. *Bulbophyllum nigripetalum* Rolfe (142) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Lip, adaxial side; f. Column and lip, lateral view; g. Anther, left: abaxial side, right: adaxial side; h. Pollinia, above: two pairs, below: single pair. – a. From *Henry 13055* (herbarium specimen); b—d, f—h. From *Morrison 1032* (spirit sample); e. From *Maxwell 89-524* (herbarium specimen).

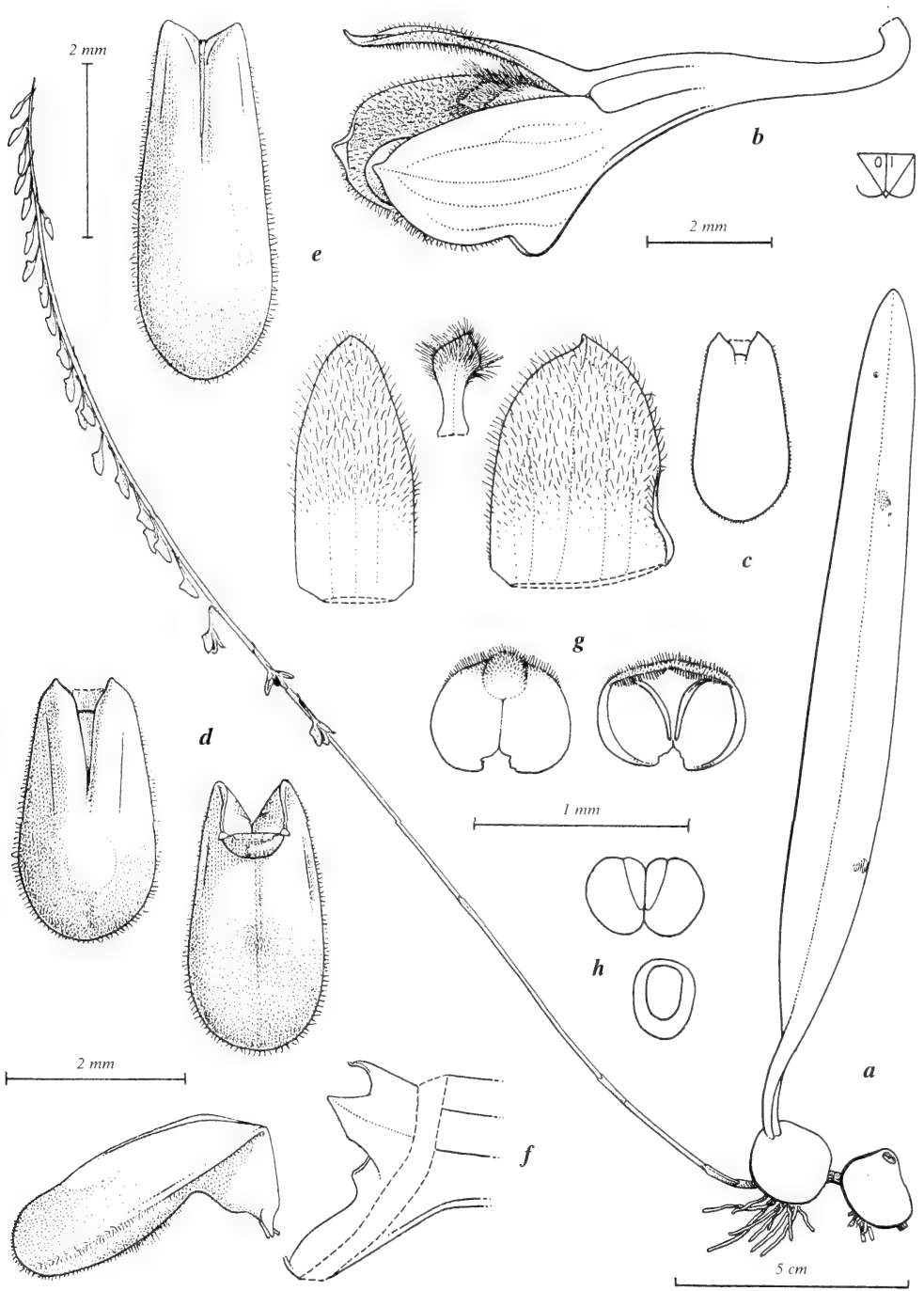


Figure 32. *Bulbophyllum nigripetalum* Rolfe (142)

width) 6—11.4; obtuse. *Inflorescence* an elongated, rather lax raceme, erect to patent, 15—49 cm, 13—32-flowered. *Peduncle* 8—25 cm, bracts c. 5, the longest 4—9 mm long. *Rhachis* not thickened, 5.5—25 cm long, glabrous. *Floral bracts* triangular, 1.8—4.5 x 1—2 mm, acuminate. *Flowers* spreading to reflexed, secund, not fully opening, many simultaneously. *Pedicel* and *ovary* 3.8—6.5 mm long, basal node on a 0.5—0.8 mm-long stump. *Median sepal* porrect to recurved, ovate to triangular, 3.1—6 x 1.3—2.2 mm, index 2—3.6; obtuse to acute, margins ciliate, base rather narrowly attached; rather thin, adaxially pubescent, abaxially glabrous. *Lateral sepals* recurved, 3—6 x 2.2—3 mm, index 1.3—2.2; otherwise as the median sepal. *Petals* ± porrect, elliptic to obovate or spatulate, 1.6—2.2 x 0.5—1 mm, index 1.8—3.6; obtuse to acuminate, margins ciliate distally, base broadly attached; rather thin with a thick tip, surface pubescent distally. *Lip* recurved in the proximal half, obovate to elliptic, 2.8—4.2 x 1—1.6 mm, index 1.8—3; rounded to obtuse, margins ciliate; thick and fleshy; adaxially somewhat concave near the base, with 3 ridges: 2 distinct, obtuse ridges diverging proximally, continuing over 1/3—3/4 of the lip, and a thin, low, sometimes inconspicuous median ridge continuing over c. 1/2 of the lip, surface glabrous, finely velutinous towards the margins; abaxially with a wide, rounded ridge near the base, surface elsewhere convex, partly or entirely velutinous. *Column* 1—1.3 mm long, stigma distinctly protruding at its base, or with a tooth slightly below its base. *Stelidia* triangular, 0.3—0.6 mm long, acute. *Anther*: front margin and abaxially towards the tip densely papillose.

Colours: Sepals cream-coloured or yellow, near the base often with blackish purple veins, sometimes blackish purple distally, or blackish purple all over. Petals blackish purple, sometimes yellowish with a purple vein proximally. Lip blackish purple, often yellowish at the base. Flowers with a lemon or turpentine scent (1 obs.)

Habitat & ecology: Epiphyte or lithophyte in forest. Alt. 1000-1300 m. Flowering in Mar—May.

Distribution: CHINA: Yunnan (1). THAILAND (3 specimens seen).

Notes: Erroneously synonymised with *Bulbophyllum secundum* by Seidenfaden (1979); it differs in having non-resupinate flowers, and adaxially pubescent sepals. It is also of larger stature.

Similar to *B. nigrescens*, it differs in having a shorter lip that is bi-convex and fleshy towards the tip. The adaxial surface is ?always (sometimes difficult to see in herbarium specimens) very finely velutinous towards the margins (glabrous in *B. nigrescens*). An additional difference may be that *B. nigripetalum* has a thin, sometimes inconspicuous median ridge instead of a median slit, as in *B. nigrescens*. The differences between the two seem

minor, but so far all material can be assigned unequivocally to one or the other species.

143. *Bulbophyllum nigrescens* Rolfe – Fig. 33, plate 26, 27.

Bulbophyllum nigrescens Rolfe, Bull. Misc. Inform., Kew (1910) 158; Seidenf. & Smitin., Orch. Thailand 3 (1961) 426 (partly, excl. fig. 319 [is *B. scaphiforme*]); Seidenf., Dansk Bot. Ark. 33, 3 (1979) 104 (partly, excl. fig. 64 [is *B. scaphiforme*]). — TYPE: Thailand, Chiangmai, Doi Suthep, *Kerr 84* (K, holo.).

Bulbophyllum angusteellipticum Seidenf., Nordic J. Bot. 1 (1981) 209. — TYPE: Thailand, Doi Inthanond, *Seidenfaden & Smitinand (GT) 8310* (C, holo., not seen).

[Not *Bulbophyllum nigrescens* Schltr., Repert. Spec. Nov. Regni Veg. Beih. 1 (1913) 839 (= *Bulbophyllum rubromaculatum* W. Kittr., Bot. Mus. Leaflet., Harvard University 30 [1981] 100).]

[Not *Bulbophyllum nigrescens sensu* Tran Hop, Orch. Vietnam (1998) 113, col. phot. 30 (= *B. scaphiforme*); S.C. Chen *et al.*, Native Orch. China (1999) 35 (= *B. nigripetalum* and *B. scaphiforme*).]

Rhizome 2—3.5 mm diam., sections between pseudobulbs 0.6—2.5 cm long. *Pseudobulbs* close, ovoid or low-conical, 0.8—1.7 x 1—2 cm. *Petiole* 0.8—2 cm. *Leaf blade* elliptic to ovate, 6—13 x 0.9—1.7 cm, index (length/width) 4—8.4; obtuse. *Inflorescence* an elongated, rather lax raceme, erect to patent, 23—44 cm, 13—27-flowered. *Peduncle* 8—22 cm, bracts c. 5, the longest 6.5—9 mm long. *Rhachis* not thickened, 9—20 cm long, glabrous. *Floral bracts* triangular, 1.8—4.5 x 1—2 mm, acuminate. *Flowers* spreading to reflexed, secund, not fully opening, many simultaneously. *Pedicel* and *ovary* 5—11 mm long, basal node on a 0.5—0.8 mm-long stump. *Median sepal* porrect to recurved, ovate to triangular, 5.5—9.5 x 1.8—3.2 mm, index 1.8—5; obtuse to acute, margins ciliate, base rather narrowly attached; rather thin, adaxially pubescent, abaxially glabrous. *Lateral sepals* recurved, 6.5—10.5 x 2.7—4.2 mm, index 1.6—3.4; otherwise as the median sepal. *Petals* ± porrect, elliptic to obovate or spatulate, 1.5—2.5 x 0.8—1.5 mm, index 1.3—3.2; obtuse to acuminate, margins ciliate distally, base broadly attached; rather thin with a thick top, surface pubescent distally. *Lip* recurved in the proximal half, obovate to elliptic, 5—7 x 2—3.3 mm, index 1.8—3.5; rounded to obtuse, margins ciliate; rather thin; adaxially somewhat concave near the base and with a median slit or furrow reaching up to 1/3—2/3 of the lip, with 2 distinct, obtuse ridges diverging proximally, continuing over 1/3—3/4 of the lip, and often ending in a patch of irregularly shaped verrucae, surface glabrous; abaxially with a wide, rounded ridge near the base, surface elsewhere concave to flat, glabrous or partly pubescent. *Column* 1.4—1.8 mm long, stigma distinctly protruding at its base, or with a distinct, obtuse to acute tooth slightly below its base. *Stelidia* triangular, 0.5—0.8 mm long, acute. *Anther*: front margin and abaxially

towards the tip densely papillose.

Colours: Sepals yellowish, stained with blackish purple and with blackish purple veins; sometimes entirely blackish purple adaxially and pale reddish brown abaxially. Petals and lip almost entirely blackish purple; the petals proximally sometimes yellow with a blackish purple vein.

Habitat & ecology: Epiphyte or lithophyte in deciduous or evergreen forest. Alt. 700–1500 m. Flowering in Jan—May, Jul.

Distribution: THAILAND (8 specimens seen). VIETNAM (1).

Notes: This has been confused with *Bulbophyllum scaphiforme* by Seidenfaden & Smitinand (1961), and Seidenfaden (1979), and with *B. scaphiforme* and *B. nigripetalum* by S.C. Chen *et al.* (1999). The differences are given below the species mentioned.

The identity of *B. angusteellipticum* has been surmised from an almost identical sample from the type locality.

144. *Bulbophyllum trulliferum* J.J. Verm. & A. Lamb – Fig. 34, plate 28.

Bulbophyllum trulliferum J.J. Verm. & A. Lamb, *Blumea* 38 (1994) 337. – TYPE: Malaysia, Sabah, Crocker Range, *Tenom Orchid Centre (T.O.C.) cult. 2321* (L. hol.).

Rhizome 1.8–2.5 mm diam., sections between pseudobulbs 0.6–1 cm long. *Pseudobulbs* ± touching, depressed conical to almost discoid, 0.4–0.7 x 1.2–2 cm. *Petiole* c. 1 cm. *Leaf blade* elliptic, 8.5–17 x 0.8–1.2 cm, index (length/width) 10–14.2; acute. *Inflorescence* an elongated, rather dense raceme, 29–32 cm, 10–14-flowered. *Peduncle* erect to patent, 27–29 cm, bracts c. 5, the longest c. 5 mm long. *Rhachis* nodding, not thickened, 2–3 cm, glabrous. *Floral bracts* ovate, c. 1 x 0.8 mm, acute. *Flowers* not fully opening, many simultaneously. *Pedicel* and *ovary* 2.5–3 mm long, finely hirsute, basal node ± flush with the surface of the rhachis. *Median sepal* porrect, ovate, 3–3.3 x 2–2.6 mm, index 1.2–1.5; rounded to obtuse, margins ciliate, base rather broadly attached; rather thin, surface adaxially glabrous, abaxially finely hirsute. *Lateral sepals* recurved, 3–3.8 x 2–3 mm, index 1.3–1.5; obtuse, margins papillose; otherwise as the median sepal. *Petals* porrect, triangular, c. 1.5–2.5 x 0.5–0.7 mm, index 3–4.3; subacute, margins ciliate, base broadly attached; thin; surface glabrous.

Figure 33. *Bulbophyllum nigrescens* Rolfe (143) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e, f, g. Lip, adaxial side; h, i. Column and lip, lateral view; j. Anther, left: abaxial side, right: adaxial side; k. Pollinia, above: single pair, below: two pairs. – a–d, h, j, k. From *Jongejan cult. 2591* (spirit sample); e. From *Cumberlege 1021* (herbarium specimen); f, i. From *Hort. Aarhus 78-B-632* (spirit sample); g. From *Maxwell 89-523* (herbarium specimen).

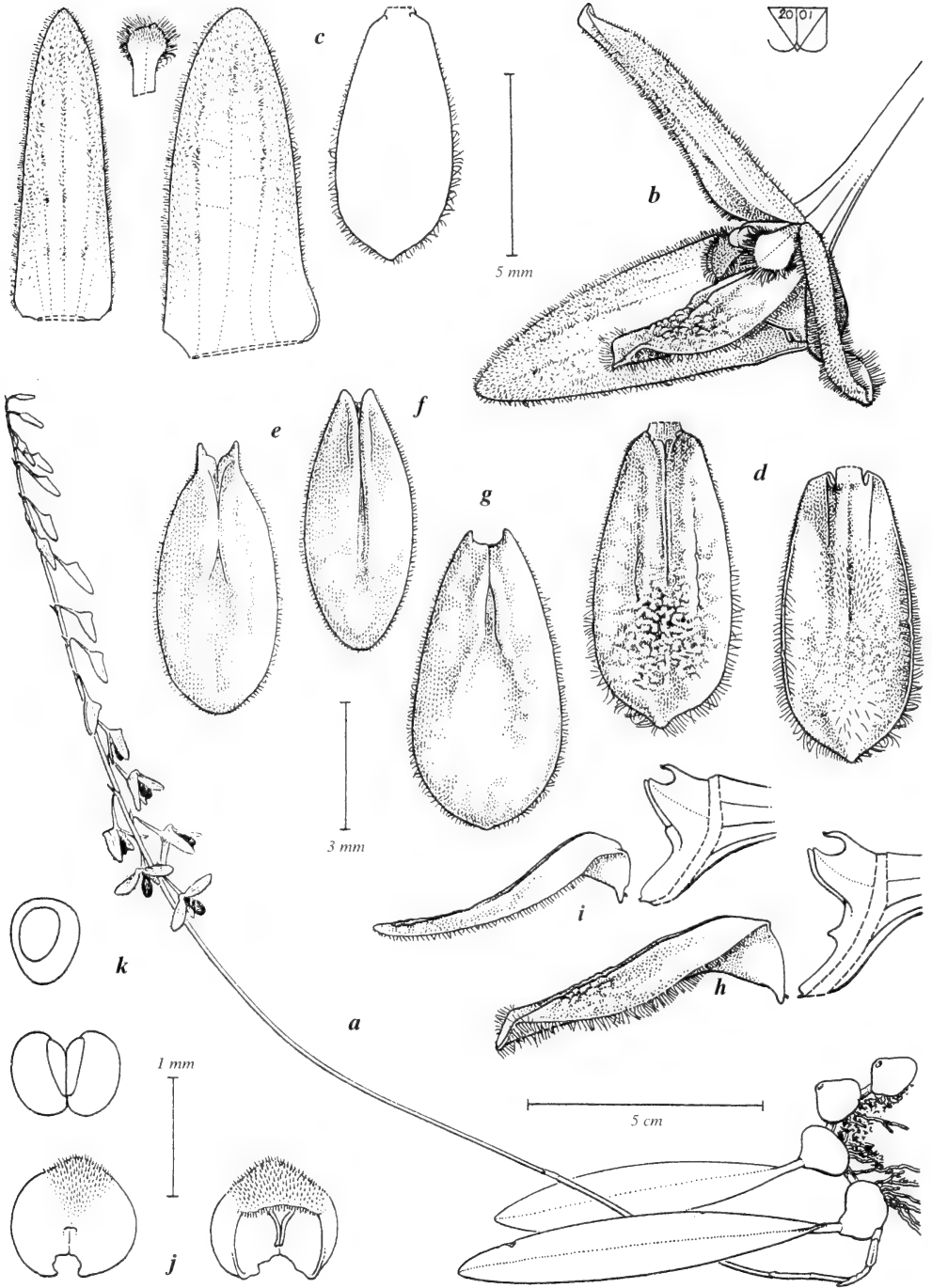


Figure 33. *Bulbophyllum nigrescens* Rolfe (143)

Lip abruptly recurved c. half-way, oblong to subspathulate, 2—2.5 x 1.1—1.4 mm, index 1.5—2.1; rounded, margins ciliate except near the base and near the tip; very thick; adaxially concave and with a bifid callus near the base, with 2 distinct, rounded ridges diverging proximally and distally, distally enclosing a circular depression, adaxial surface glabrous; abaxially with a wide, retuse ridge proximally, convex and with thick, stiff, long hairs towards the margins distally, surface otherwise glabrous. *Column* 1.6—1.7 mm long, stigma protruding at its base. *Stelidia* narrowly triangular, c. 1 mm long, acute, with a small, deltoid, obtuse tooth along the upper margin, and a larger, antrorse, triangular obtuse tooth along the lower margin, near the base. *Anther*: front margin ciliate, abaxial surface with an inconspicuous ridge only, \pm glabrous.

Colours: Flowers cream-coloured; sepals with a reticulate pattern of pale purple veins; petals with the vein, margin and cilia pale purple; lip orange towards the base, adaxially with a large, blackish spot near the tip; hairs white.

Habitat & ecology: Epiphyte in primary forest. Alt. c. 900 m. Flowering observed in Sep.

Distribution: MALAYSIA: Sabah, Crocker Range (3 specimen seen).

145. *Bulbophyllum jolandae* J.J. Verm. — Fig. 35.

Bulbophyllum jolandae J.J. Verm., Orch. Borneo 2 (1991) 241, **colour photograph pl.**

16f. — TYPE: Malaysia, Sabah, Ulu Padas, *Vermeulen 602* (L, holo.).

Rhizome c. 3 mm diam., sections between pseudobulbs 0.6—0.8 cm long. *Pseudobulbs* touching, ovate, 1.2—1.5 x 1—1.2 cm. *Petiole* 2—2.5 cm. *Leaf blade* elliptic, 8.5—9.5 x 2—2.3 cm, index (length/width) 4—4.3; acute. *Inflorescence* an elongated, very lax raceme, 25—42 cm, 4—14-flowered. *Peduncle* erect to patent, 20—22 cm, bracts c. 4, the longest c. 6 mm long. *Rhachis* not thickened, erect or arching, 5—21 cm long, glabrous. *Floral bracts* triangular, 2.5—3 x 1 mm, acuminate. *Flowers* opening wide, several simultaneously, anthesis from the base of the rhachis upwards. *Pedicel* and *ovary* 48—50 mm long, basal node on a c. 1.5 mm-long stump. *Median sepal* reflexed, triangular, c. 18.5 x 2 mm, index 9.2—9.3; caudate, margins ciliolate near base, base rather broadly attached; thin, surface glabrous. *Lateral sepals* ovate-triangular, c. 20 x 4.5 mm, index 4.4—4.5; acute-

Figure 34. *Bulbophyllum trulliferum* J.J. Verm. (144) — a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, left: adaxial side, right: abaxial side; g. Pollinia, above: two pairs, below: single pair. — a. Modified after a sketch and a photograph of A. Lamb; b—g. All from *Tenom Orchid Centre cult. 2321* (spirit sample).

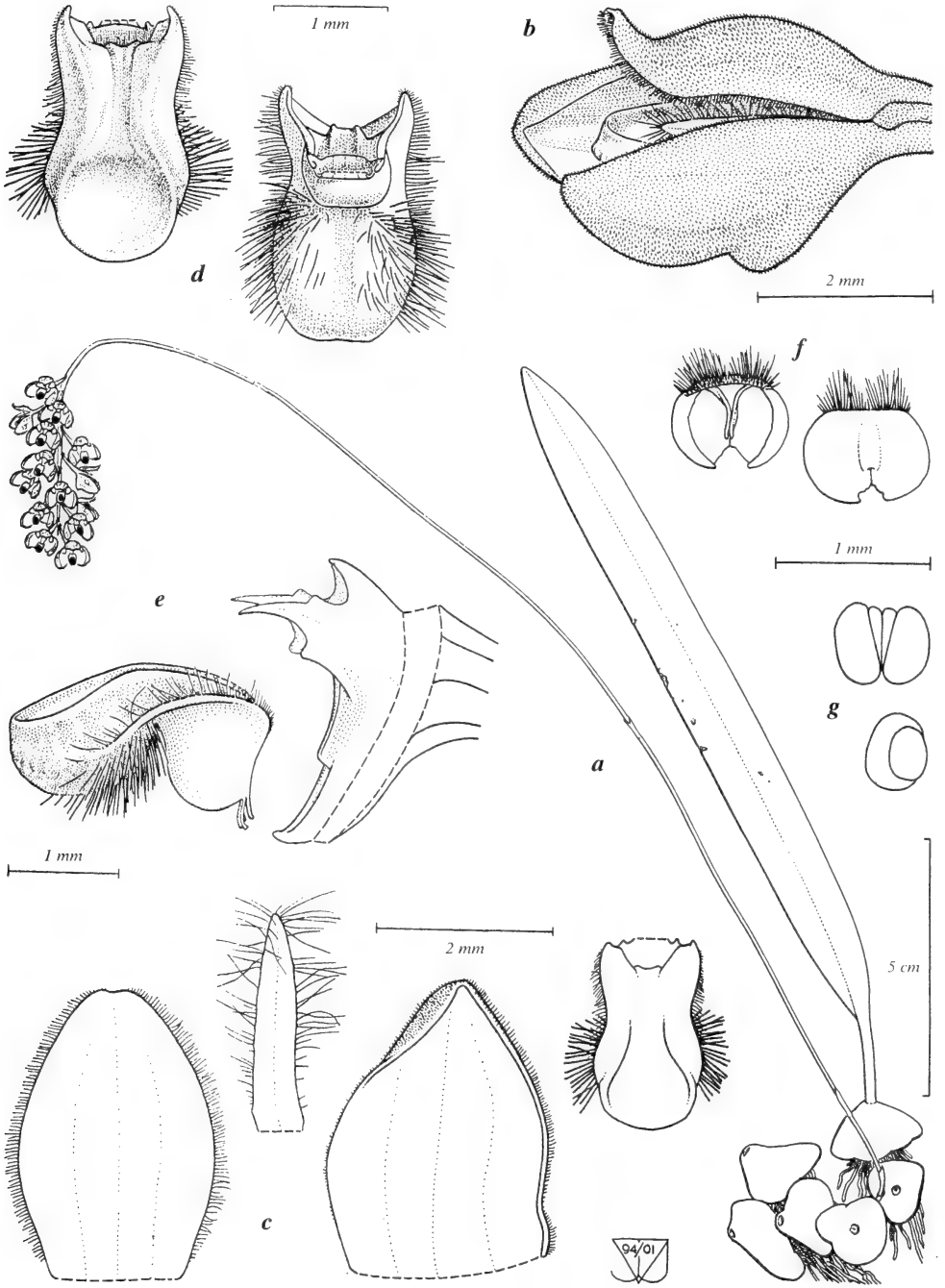


Figure 34. *Bulbophyllum trulliferum* J.J. Verm. (144)

acuminate, upper margin glabrous; otherwise as the median sepal. *Petals* porrect, falcate, triangular, c. 4.2 x 1.2 mm, index 3.5; acuminate, margins ciliate except near the tip, base broadly attached; thin, surface glabrous. *Lip* curved in the basal half, \pm elliptic to ovate, c. 7.5 x 2.8 mm, index 2.6—2.7; rounded, margins ciliate, and with long, thin, \pm straight hairs except near the base and near the tip; lip rather thin with a thick base, surface glabrous; adaxially concave near the base, with a median slit proximally opening into a small cavity and distally continuing over c. 1/3 of the lip, with two rounded ridges continuing over c. 1/3 of the lip, proximally diverging and almost fused to a single median ridge distally; abaxially with a retuse ridge near the base. *Column* c. 2 mm long, stigma protruding at its base. *Stelidia* c. 0.7 mm long, tip acute; \pm rectangular in outline with an antrorse, deltoid, subacute tooth along the upper and lower margin. *Anther*: front margin long ciliate, abaxial surface papillose.

Colours: Sepals proximally somewhat glaucous green, distally yellowish, medium green in between. Petals greenish, purplish near the base, margins and cilia purple. Lip purplish except for a paler patch near the base, short hairs white, long hairs purple. Column greenish, blotched purple.

Habitat & ecology: Epiphyte in moss, in open montane *kerangas* forest. Alt. c. 1500 m. Flowering observed in Oct.

Distribution: MALAYSIA: Sabah, Ulu Padas (1 specimen seen).

146. *Bulbophyllum comberipictum* J.J. Verm., *sp. nov.* – Fig. 36.

Bulbophyllum comberipictum J.J. Verm., a *Bulbophyllo jolandae* pedicello cum ovario 8—20 mm longo, labello pilis tenuibus lanatis differt. – TYPE: Malaysia, Sarawak, Hose Mts., *Hort. Leiden 914194* (L, holo.).

Bulbophyllum sp. Comber, *Orchids of Sumatra* (2001) 816, **colour photograph**.

Rhizome c. 3 mm diam., sections between pseudobulbs 0.6—1.2 cm long. *Pseudobulbs* close or touching, ovate-conical, c. 1.5 x 1.5 cm. *Petiole* c. 2.5 cm. *Leaf blade* elliptic, c. 10.5 x 3.1 cm, index (length/width) c. 3.3; acute. *Inflorescence* an elongated, rather dense raceme, c. 32 cm, 26—31-flowered. *Peduncle* erect to patent, c. 18.5 cm, bracts c. 4, the longest c. 7 mm long. *Rhachis* not thickened, c. nodding, c. 13.5 cm long, glabrous. *Floral bracts* triangular, c. 2.5 x 1 mm, acuminate. *Flowers* opening wide, several simultaneously, anthesis from the base of the rhachis upwards. *Pedicel* and *ovary* 8—20 mm long, basal node on a c. 1 mm-long stump.

Figure 35. *Bulbophyllum jolandae* J.J. Verm. (145) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, above: abaxial side, below: adaxial side. – All from *Vermeulen 602* (living plant).

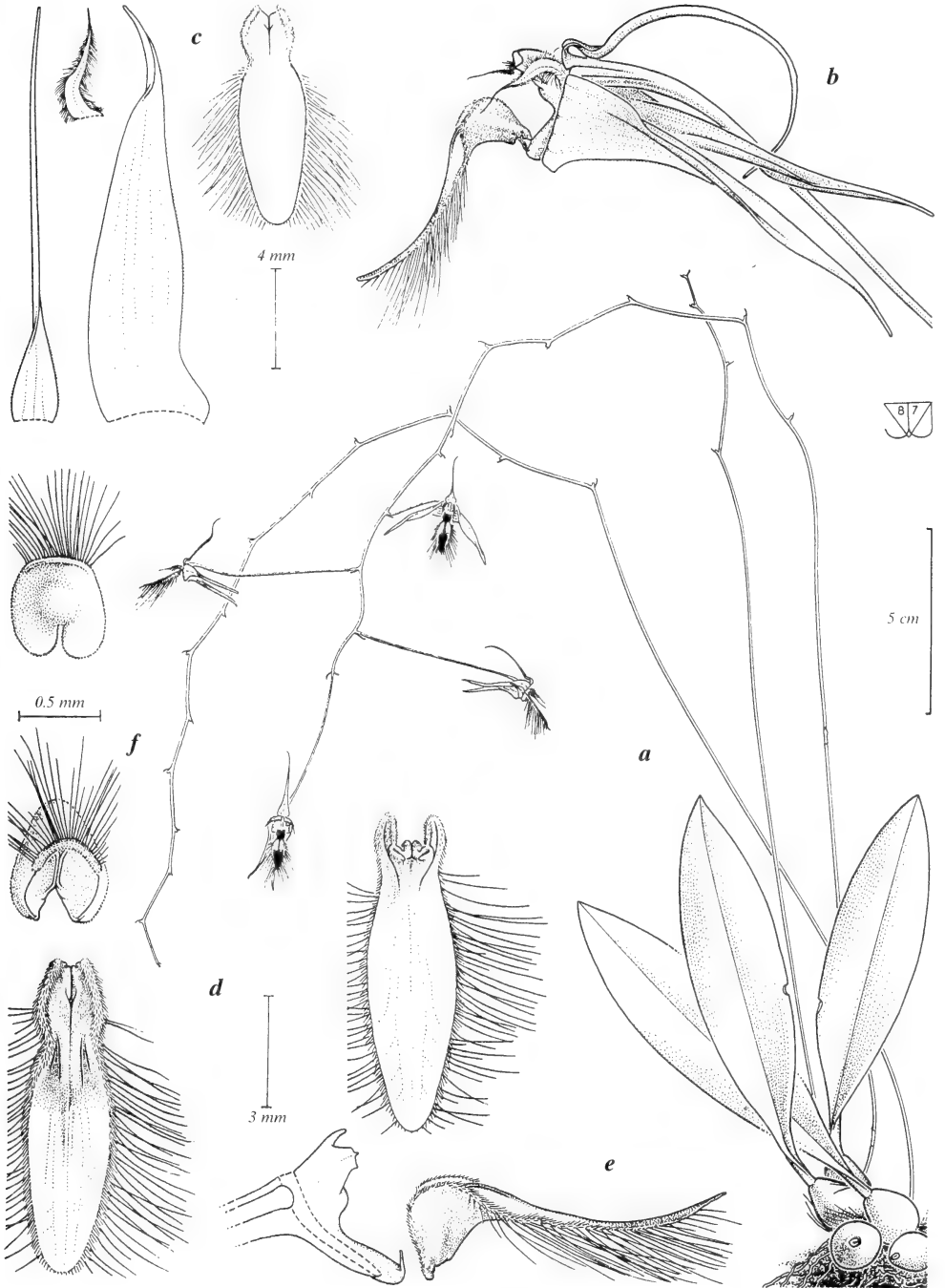


Figure 35. *Bulbophyllum jolandae* J.J. Verm. (145)

Median sepal c. porrect to reflexed, triangular, c. 7 x 1.4 mm, index c. 5; tapering towards the tip and acute, base rather broadly attached; thin, glabrous. *Lateral sepals* ovate-triangular, c. 7 x 2.2–2.4 mm, index 2.9–3.2; subacute; otherwise as the median sepal. *Petals* porrect, falcate, triangular, 2.7–2.8 x 0.6–0.9 mm, index 3.1–4.5; acuminate, margins ciliate except near the base and near the tip, base broadly attached; thin, surface glabrous. *Lip* curved in the basal half, \pm elliptic, c. 4.5 x 1.2–1.3 mm, index 3.4–3.8; truncate, margins ciliate near the base and at the tip, in between with long, thin, distinctly wavy hairs; lip rather thin with a thick base, surface glabrous; adaxially concave near the base, with a median slit proximally opening into a small cavity and distally continuing over c. 4/5 of the lip, with two rounded ridges continuing over c. 4/5 of the lip, diverging proximally and almost fused to a single median ridge distally; abaxially with a retuse ridge near the base. *Column* c. 1.3 mm long, stigma protruding at its base. *Stelidia* c. 0.4 mm long, tip acute; \pm rectangular in outline with an antrorse, deltoid, subacute tooth along the upper and lower margin. *Anther*: front margin long ciliate, abaxial surface \pm glabrous.

Colours: Sepals creamy yellow, the median flushed with some purple along the margins. Petals blackish purple, with purple cilia. Lip whitish, marked with dark purple towards the tip and along the margins; hairs purple.

Habitat & ecology: Recorded from submontane *kerangas* forest, and from a steep, densely forested ravine cut into volcanic soil. Alt. 800–1300 m. Flowering observed in Nov.

Distribution: MALAYSIA: Sarawak, Hose Mts. (1 specimen seen). INDONESIA: Sumatra (photo Comber, see below).

Notes: Similar to *Bulbophyllum jolandae* but distinct because of its much denser inflorescence with much smaller flowers on shorter pedicels. The lip has a more distinct and distinctly longer median ridge (reaching up to 4/5 of the length of the lip), and distinctly woolly rather than straight hairs.

For a while this species was known only from a photograph by Comber in Sumatra; the specific name refers to this. It was not found again in spite of an extensive search of the same locality. The photograph shows a plant almost identical to the Sarawak specimen, but with narrower leaves.

Figure 36. *Bulbophyllum comberipictum* J.J. Verm. (146) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Column and lip, lateral view; f. Anther, left: abaxial side, right: adaxial side; g. Pollinia, above: two pairs, below: single pair. – All from Hort. Leiden 914194 (spirit sample).

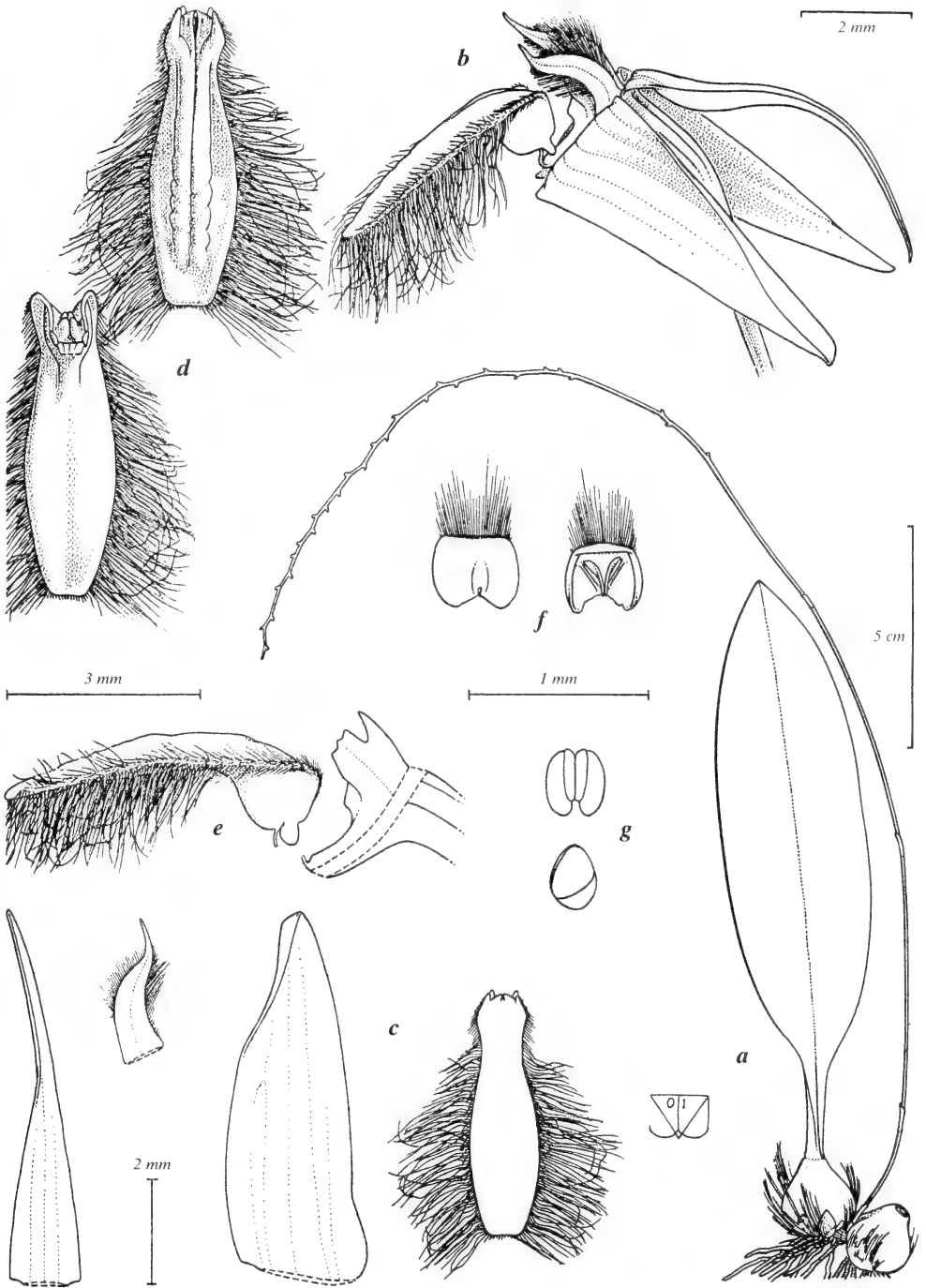


Figure 36. *Bulbophyllum comberipictum* J.J. Verm. (146)

147. *Bulbophyllum lasioglossum* Rolfe ex Ames – Fig. 37, plate 29.

Bulbophyllum lasioglossum Rolfe ex Ames, Orch. 1 (1905) 100. — TYPE: Philippines, Luzon, Bataan, Mt. Mariveles, Lamao River, *Borden 797* (PNH, holo., destroyed; AMES, K, iso.).

Rhizome 1.8—3 mm diam., sections between pseudobulbs 0.6—0.8 cm long. *Pseudobulbs* ± touching, ovoid, 0.7—1.5 x 0.5—0.8 cm. *Petiole* 1.4—2.6 cm. *Leaf blade* elliptic to ovate, 5.8—12 x 1.5—3.2 cm, index (length/width) 2.6—4.7; (sub-)acute. *Inflorescence* an elongated, rather lax raceme, 16—33 cm, 21—44-flowered. *Peduncle* erect to patent, 11.5—19 cm, bracts c. 5, the longest 6—8 mm long. *Rhachis* nodding, not thickened, 5—14.5 cm, glabrous. *Floral bracts* triangular, 1.5—3 x 0.8—1.2 mm, acute. *Flowers* opening wide, several simultaneously, anthesis from the top of the rhachis downwards. *Pedicel* and *ovary* 7.5—14 mm long, basal node on a 0.4—1 mm-long stump. *Median sepal* porrect to recurved, elliptic, 6.5—9 x 2—2.2 mm, index 3.2—4.1; acute to acuminate, margins ciliate, base rather narrowly attached; thin, surface glabrous. *Lateral sepals* recurved or spreading, ovate-triangular, 6.5—9 x 2.5—2.6 mm, index 2.6—3.6; margins glabrous, base broadly attached; otherwise as the median sepal. *Petals* porrect, ovate, 2.5—3.2 x 0.6—1 mm, index 3—4.6; acute, margins ciliate, base broadly attached; thin, surface glabrous. *Lip* curved near the base, obscurely 3-lobed; *midlobe* ovate, 5—7 x 1.2—2.2 mm, index 2.7—4.2; rounded to obtuse, margins distally ciliate, otherwise with long, thin, straight or slightly wavy hairs; rather thin with a thick base, surface glabrous; adaxially concave near the base and with a median slit reaching up to 1/3 of the lip, with two obtuse ridges diverging proximally towards the distal end of the lateral lobes, distally fused to a single median ridge and continuing over c. 1/3 of the lip, surface otherwise slightly concave; abaxially with a wide, retuse ridge near the base; *lateral lobes* attached along the proximal 1/6 of the lip, erect, semi-circular, margins ciliate, broadly attached, rather thick, adaxially pubescent towards the margins, abaxially glabrous. *Column* 1.2—1.5 mm long, stigma with a distinct, deeply bifid callus at the base. *Stelidia* semi-elliptic, c. 0.5 mm long, tip acute, margins distally slightly erose. *Anther*: front margin deeply bifid, papillose, abaxial surface distally papillose.

Colours: Rhachis brownish purple. Pedicel and ovary green. Sepals and petals pale (yellowish) green. Lip dark purplish brown, or ?yellowish.

Figure 37. *Bulbophyllum lasioglossum* Rolfe ex Ames (147) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: abaxial side, right: adaxial side; e. Column and lip, lateral view; f. Anther, left: adaxial side, right: abaxial side; g. Pollinia, above: two pairs, below: single pair. – a, c—g. From *Borden 797*; b. From *Topping s.n.* (all herbarium specimens).

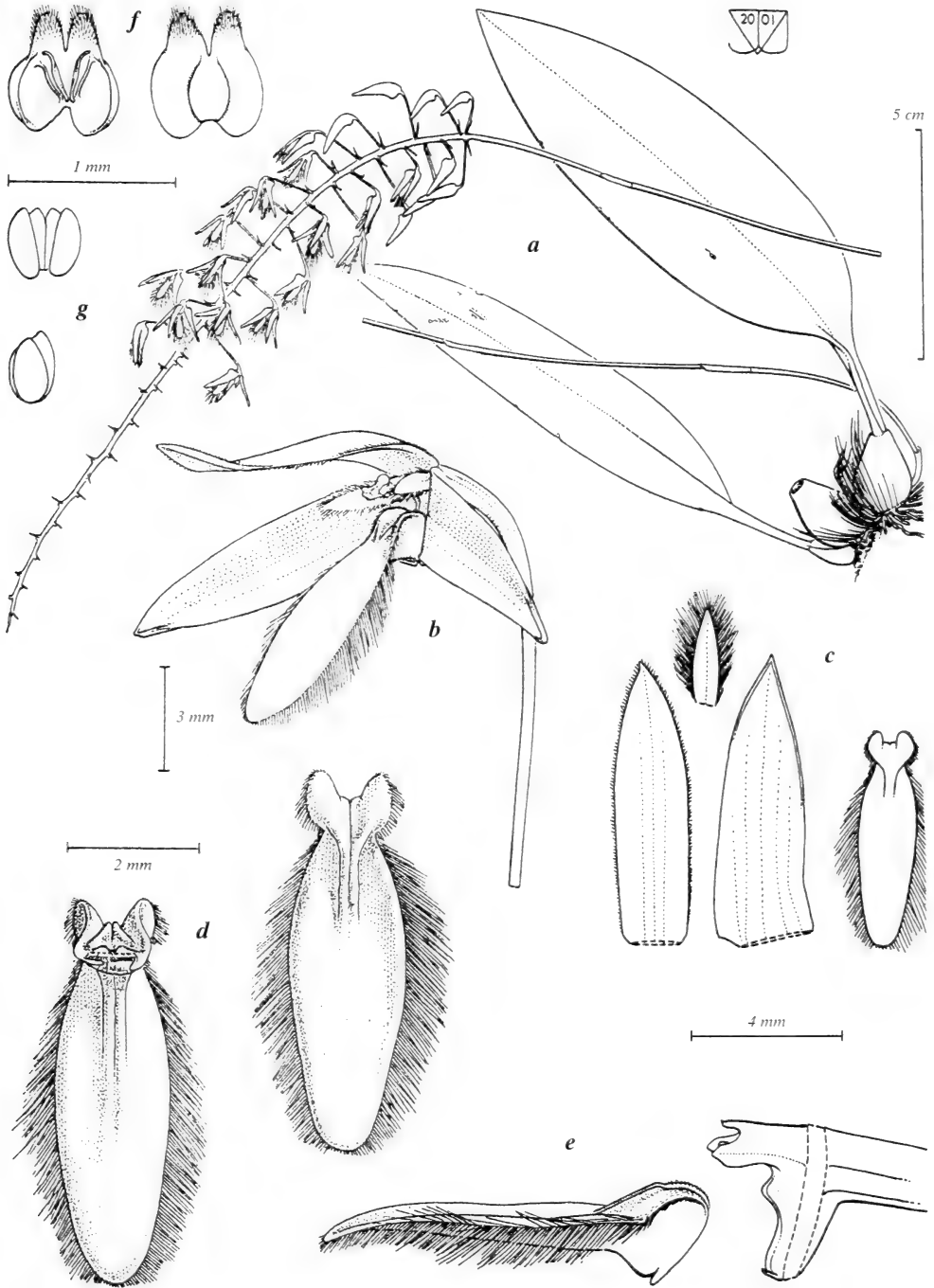


Figure 37. *Bulbophyllum lasioglossum* Rolfe ex Ames (147)

Habitat & ecology: Epiphyte in montane forest. Alt. c. 1000 m. Flowering in May—Jun.

Distribution: PHILIPPINES: Luzon (3 specimens seen).

148. *Bulbophyllum negrosianum* Ames – Fig. 38, plate 30.

Bulbophyllum negrosianum Ames, Leafl. Philipp. Bot. 5 (1912) 1586. — TYPE: Philippines, Negros, Negros Oriental, Cuernos Mts., Dumaguete, *Elmer 9821* (PNH, holo., destroyed; AMES, NY, iso.).

Rhizome 3—4 mm diam., sections between pseudobulbs 0.8—2 cm long. *Pseudobulbs* ± touching, ovoid, 1.5—2.5 x 1—1.6 cm. *Petiole* 2—5 cm. *Leaf blade* elliptic, 8.5—16 x 3.2—4.6 cm, index (length/width) 2.2—4.7; subacute. *Inflorescence* an elongated, rather dense raceme, ± patent, c. 42 cm, c. 45-flowered. *Peduncle* c. 23.5 cm, bracts c. 5, the longest c. 9 mm long. *Rhachis* not thickened, c. 18.5 cm, glabrous. *Floral bracts* triangular, 1.5—2 x 0.8—1 mm, acute. *Flowers* secund, several open simultaneously, not fully open, anthesis from the top of the rhachis downwards. *Pedicel* and *ovary* 5.5—6.5 mm long, basal node on a 0.3—0.5 mm-long stump. *Median sepal* recurved, elliptic, 5.5—5.8 x 2.2—3 mm, index 1.8—2.7; acute-acuminate, margins ciliate, base rather narrowly attached; thin, surface glabrous. *Lateral sepals* recurved, ovate, 5.5—5.8 x 3—3.5 mm, index 1.5—2; margins glabrous, base broadly attached; otherwise as the median sepal. *Petals* porrect, elliptic to ovate, 3—3.5 x 0.7—1 mm, index 3.5—4.3; subacute, margins ciliate, base broadly attached; thin, surface glabrous. *Lip* curved near the base, obscurely 3-lobed; *midlobe* elliptic to obovate, c. 4 x 1.5—2.3 mm, index 1.7—2.7; obtuse, margins with long, thin, straight or slightly wavy hairs; rather thin with a thick base, surface glabrous; adaxially concave near the base and with a median slit reaching up to 1/4 of the lip, with two obtuse ridges diverging proximally towards the distal end of the lateral lobes, distally fused to a distinct, thick callus with two knobs at about 1/3 the way up of the lip, a third, obtuse median ridge issuing distally from this callus, bordered by distinct furrows and continuing over c. 3/4 of the lip, surface otherwise concave; abaxially with a wide, retuse ridge near the base; *lateral lobes* attached along the proximal 1/5 of the lip, erect, semi-circular, margins with hairs, broadly attached, rather thick, adaxially pubescent towards the margins, abaxially glabrous. *Column* 1.3—1.6 mm

Figure 38. *Bulbophyllum negrosianum* Ames (148) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Lip, adaxial side; f. Column and lip, lateral view; g. Anther, above: adaxial side, below: abaxial side; h. Pollinia, above: two pairs, below: single pair. – a—d, f—h. From *Elmer 9821* (herbarium specimen); e. From *Hort. Vienna 176-90* (spirit sample).

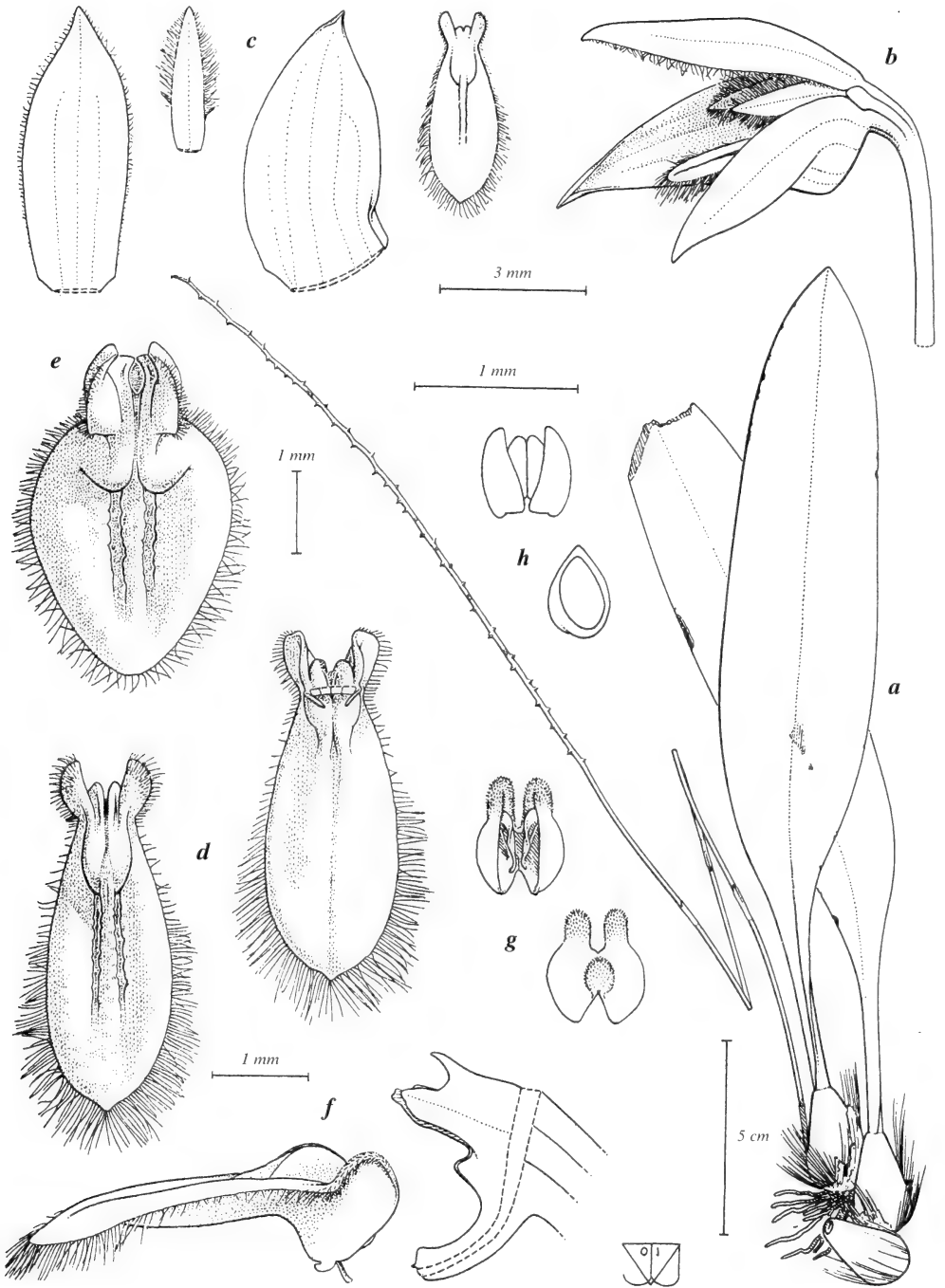


Figure 38. *Bulbophyllum negrosianum* Ames (148)

long, stigma with a distinct, deeply bifid callus at the base. *Stelidia* semi-elliptic, c. 0.5 mm long, tip obtuse, margins distally erose. *Anther*: front margin deeply bifid, papillose, abaxial surface distally papillose.

Colours: Sepals dull purple, the median whitish between the veins in the centre; or sepals orange yellow with dark red veins proximally, orange red distally. Petals dark red, with a yellowish midvein; cilia yellow. Lip yellow, adaxial side reddish brown in the centre, abaxial side with a dark red patch about half-way, pale yellow proximally. Hairs along lip margins yellow.

Habitat & ecology: Epiphyte in mossy montane forest. Alt. 1200—1400 m. Flowering in Apr, May.

Distribution: PHILIPPINES: Luzon (1 specimen seen); Negros (1).

Notes: Flowers rather similar to those of the preceding species. They differ in being smaller, and in the presence of a distinct callus adaxially on the lip, where the two lateral keels meet.

The Luzon specimen has wider floral parts than the type from Negros, but is otherwise not different.

149. *Bulbophyllum dracunculus* J.J. Verm. – Fig. 39, plate 31.

Bulbophyllum dracunculus J.J. Verm., Gard. Bull. Singapore 52 (2000) 276. — TYPE: Malaysia, Sabah, NE flank of Gunung Alab, *Hort. Leiden* 30978 (L, holo., SING, iso.).

Bulbophyllum polygaliflorum sensu J.J. Wood, *Orch. Borneo* 3 (1997) 247 (colour photograph only), non J.J. Wood.

Rhizome 2.5—2.7 mm diam., sections between pseudobulbs 0.4—1 cm long. *Pseudobulbs* touching, ovoid, 0.7—1.6 x 0.4—1.4 cm. *Petiole* 0.4—1.3 cm. *Leaf blade* elliptic to ovate, 5.1—8.1 x 1.2—3 cm, index (length/width) 2.7—5; obtuse to acute. *Inflorescence* an elongated, lax raceme, ± patent, 15—24 cm, 11—20-flowered. *Peduncle* 10—18 cm, bracts c. 4, the longest 4—6 mm long. *Rhachis* not thickened, 5—7 cm long, glabrous. *Floral bracts* triangular, 1.5—2.8 x 2—2.2 mm, slightly acuminate. *Flowers* not fully opening, one at a time. *Pedicel* and *ovary* 4—4.5 mm long, basal node ± flush with the surface of the rhachis. *Median sepal* ± porrect, triangular, 4—5 x 1.3—2 mm, index 2.5—3.1; acute to acuminate, margins ciliate, base rather broadly attached; rather thick, surface glabrous. *Lateral sepals* recurved, ovate, 4.5—6.3 x 2.8—4.2 mm, index 1.2—1.6; rounded to

Figure 39. *Bulbophyllum dracunculus* J.J. Verm. (149) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, left: abaxial side, right: adaxial side; g. Pollinia, above: two pairs, below: single pair. – All from *Hort. Leiden* 30978 (spirit sample).

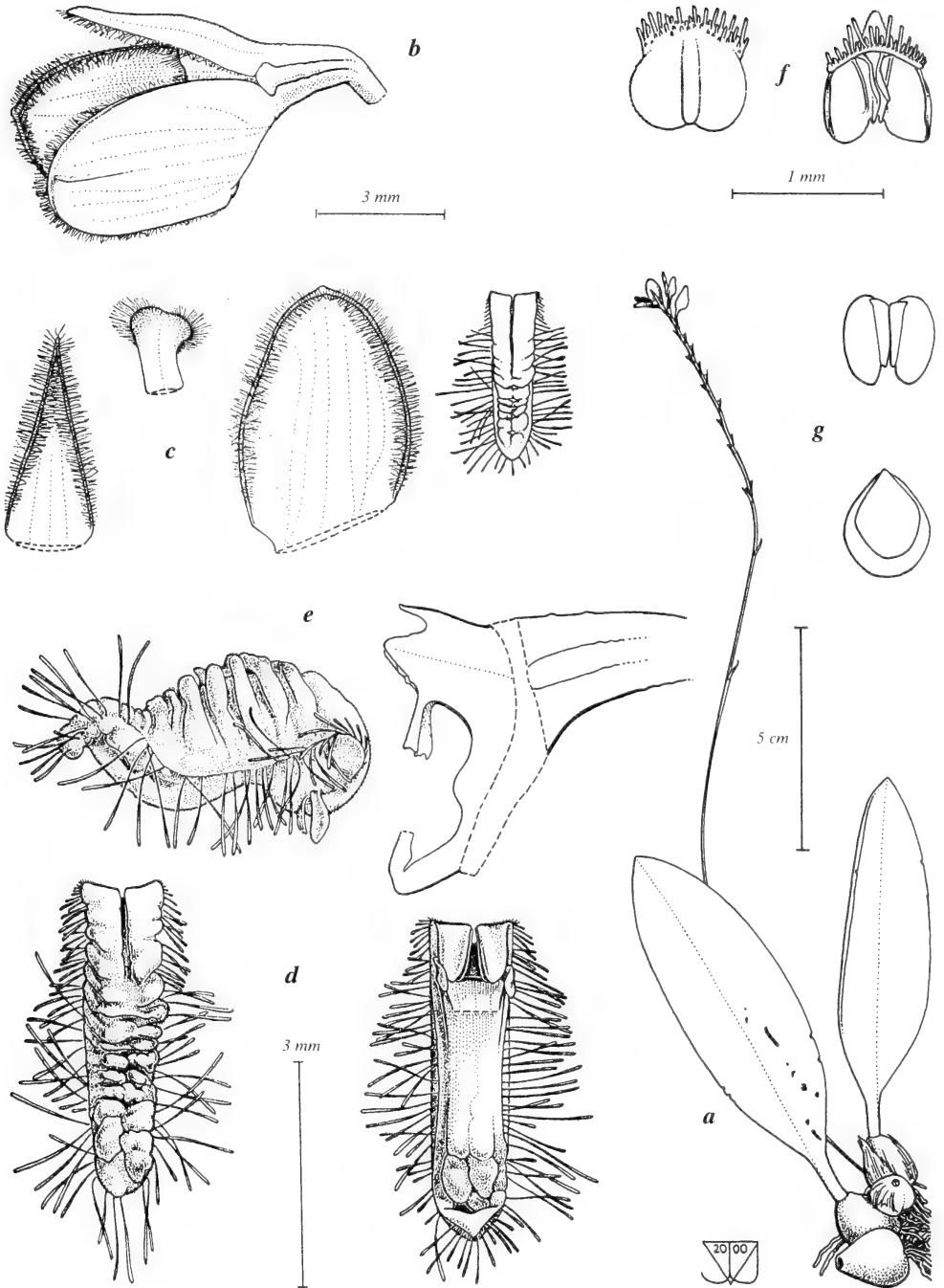


Figure 39. *Bulbophyllum dracunculus* J.J. Verm. (149)

obtuse, otherwise as the median sepal. *Petals* porrect, spatulate, 1.6—2.3 x 1.1—1.5 mm, index 1.1—1.9; truncate to retuse, margins ciliate, base rather broadly attached; rather thick, adaxial surface glabrous but with two hirsute patches near the top. *Lip* recurved near the base, oblong, 3.5—4.2 x 0.8—1.2 mm, index 3.5—4.3; obtuse, margins with slightly club-shaped hairs increasing in length and thickness towards the tip of the lip; very thick; adaxially \pm flat near the base and with a median slit up to 1/3 of the lip, with 2 rows of irregularly shaped, fleshy calli, those on opposite rows partly fused c. half-way up the lip, adaxial surface finely papillose; abaxially with a truncate ridge distally divided in two rows of fleshy calli, surface glabrous. *Column* 1.2—1.8 mm long, column foot with two longitudinal, rounded lamellae. *Stelidia* triangular, 0.5—0.7 mm long, obtuse, with a distinct, downwards projecting, strap-shaped to somewhat spatulate tooth with a 2—3-furcate tip along the lower margin and sometimes with a second, minute, deltoid, obtuse to acute tooth just in front of this. *Anther*: front margin long-papillose, abaxial ridge papillose.

Colours: Peduncle dark purple, rhachis paler. Bracts pale green, suffused pale lilac. Sepals yellowish or pale green, suffused brownish red adaxially, margins with white or pink cilia. Petals translucent white, spotted with purple adaxially, margins with dark purple hairs. Lip creamy white, yellowish or pinkish, calli blackish purple, hairs purple.

Habitat & ecology: High montane forest, secondary forest, shrubby vegetation on soils derived from ultrabasic rock. Alt. 800-1800 m. Flowering in Jan, Apr, Jun—Aug.

Distribution: MALAYSIA: Sabah (4 specimens seen).

150. *Bulbophyllum polygaliflorum* J.J. Wood – Fig. 40.

Bulbophyllum polygaliflorum J.J. Wood, Kew Bull. 39 (1984) 96; J.J. Wood, Orch. Borneo 3 (1997) 247 (excl. colour photo, is *B. dracunculus* J.J. Verm.). — TYPE: Malaysia, Sarawak, *Hansen 499* (C, holo.; K, iso.).

Rhizome c. 6 mm diam., sections between pseudobulbs 1.5—4.5 cm long. *Pseudobulbs* distant, ovoid, 2—4.2 x 0.8—1.6 cm. *Petiole* 1.8—4 cm. *Leaf blade* elliptic to ovate, 9—18 x 3.2—4.7 cm, index (length/width) 2.5—4.2; acute. *Inflorescence* an elongated, rather dense raceme, erect to patent, 78—86 cm, 30—45-flowered. *Peduncle* 63—70 cm, bracts 5—9, the

Figure 40. *Bulbophyllum polygaliflorum* J.J. Wood (150) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, above: adaxial side, below: abaxial side; g. Pollinia, left: single pair, right: two pairs. – a (plant), b—g. From *SFN 27956* (herbarium specimen), = *Carr 3595* (spirit sample); a (inflorescence). From *Hansen 499* (herbarium specimen).

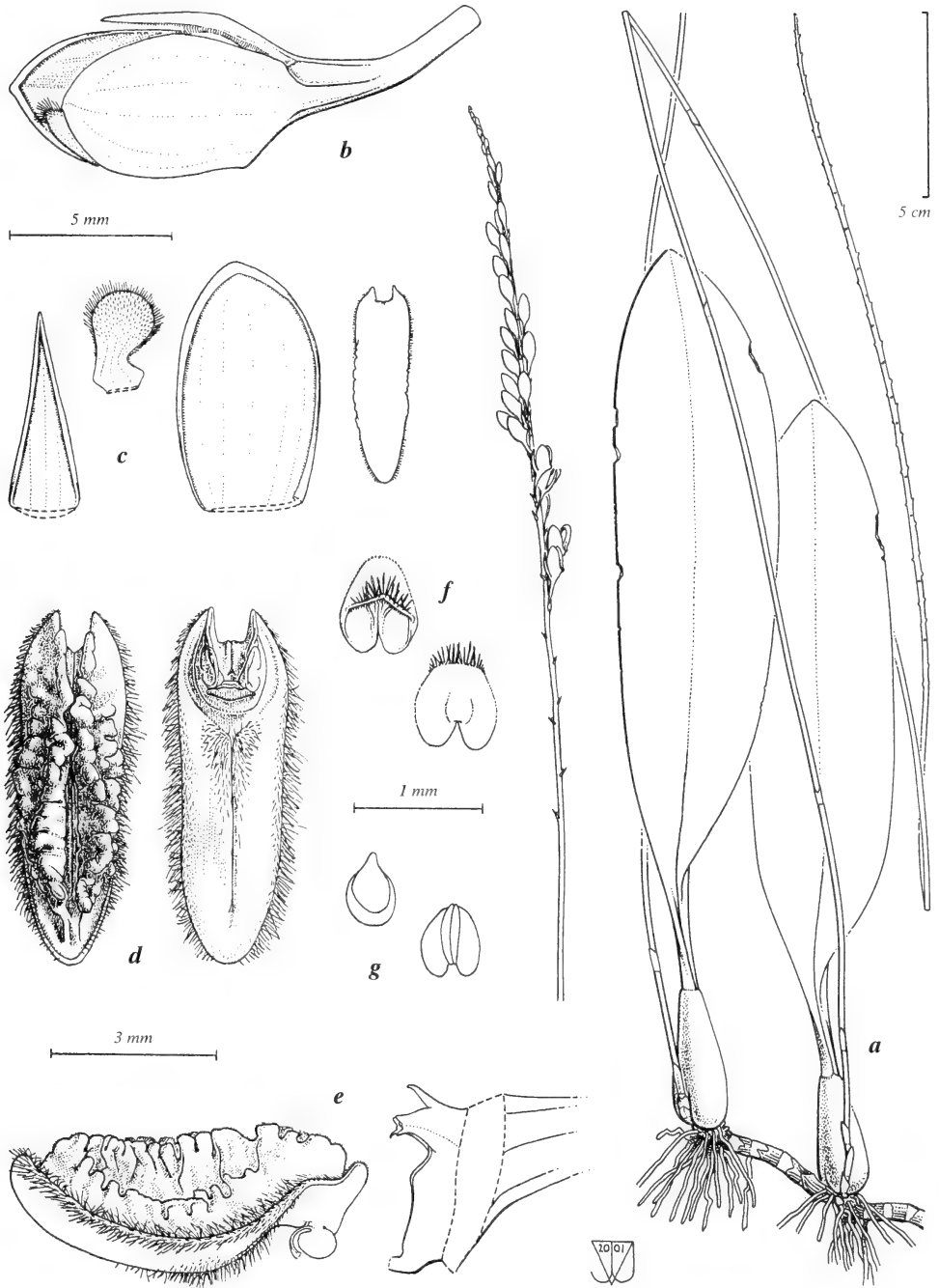


Figure 40. *Bulbophyllum polygaliflorum* J.J. Wood (150)

longest 10 mm long. *Rhachis* not thickened, 15–18 cm long, glabrous. *Floral bracts* ovate, 2–3 x 1.5–2 mm, acuminate. *Flowers* not fully opening, several simultaneously. *Pedicel* and *ovary* 5–6.5 mm long, basal node \pm flush with the surface of the rhachis. *Median sepal* \pm porrect, triangular, 6–6.4 x 1.5–2.4 mm, index 2.6–4; acute to acuminate, margins ciliolate, base broadly attached; thick, surface glabrous. *Lateral sepals* somewhat recurved, ovate to elliptic, 7.5–9 x 4.8–5 mm, index 1.5–1.8; obtuse, otherwise as the median sepal. *Petals* porrect, spathulate with a widened base, 3–3.5 x c. 2 mm, index 1.5–1.8; rounded, margins ciliate, base rather broadly attached; rather thick, surface hirsute towards the tip. *Lip* recurved near the base, elliptic to ovate, 6–6.8 x 2–2.5 mm, index 2.7–3; obtuse, margins densely ciliate; very thick; adaxially concave near the base, with a median slit over most of its length, with 4 rows of irregularly shaped, fleshy calli, the two inner rows higher and longer than the two outer, adaxial surface finely and shortly hirsute; abaxially with a rounded ridge near the base, surface otherwise convex with a median slit, pubescent in the centre and along the margins. *Column* 1–1.2 mm long, column foot with two longitudinal, rounded lamellae. *Stelidia* triangular, c. 0.5 mm long, acute, with a large, antrorse, deltoid, acute tooth along the upper margin, and a similar but much smaller, slightly falcate, triangular tooth along the lower. *Anther*: front margin ciliate, abaxial ridge papillose.

Colours: Sepals greenish, marked with pale purple, or purple, cilia white. Petals translucent near the base, blackish purple near the tip, cilia yellow. Lip greenish, upper surface with blackish green warts and yellow indument, sides with yellow cilia. Column whitish, spotted purple.

Habitat & ecology: Epiphyte in montane forest. Alt. 1700–1800 m.

Distribution: MALAYSIA: Sarawak (1 specimen seen). Sabah (2).

151. *Bulbophyllum ochthodes* J.J. Verm., sp. nov. – Fig. 41, plate 32.

Bulbophyllum ochthodes J.J. Verm., a *Bulbophyllo polygalifloro* labelli latere adaxiali tantum callis in seriebus duabus differt. – TYPE: Malaysia, further details unknown, *Hort. Singapore SBG-O 616* (SING, holo.; K, KLU, iso.).

Rhizome 4–7 mm diam., sections between pseudobulbs 2–6 cm long. *Pseudobulbs* distant, ovoid, 1.8–3.5 x 0.7–1.5 cm. *Petiole* 1–3.5 cm. *Leaf blade* elliptic, 7.5–14 x 2.7–4.5 cm, index (length/width) 2.6–4; acute. *Inflorescence* an elongated, rather dense raceme, \pm erect, 26–58 cm, 40–

Figure 41. *Bulbophyllum ochthodes* J.J. Verm. (151) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, left: adaxial side, right: abaxial side; g. Pollinia, left: single pair, right: two pairs. – All from *Hort. Singapore SBG-O 616* (spirit sample).

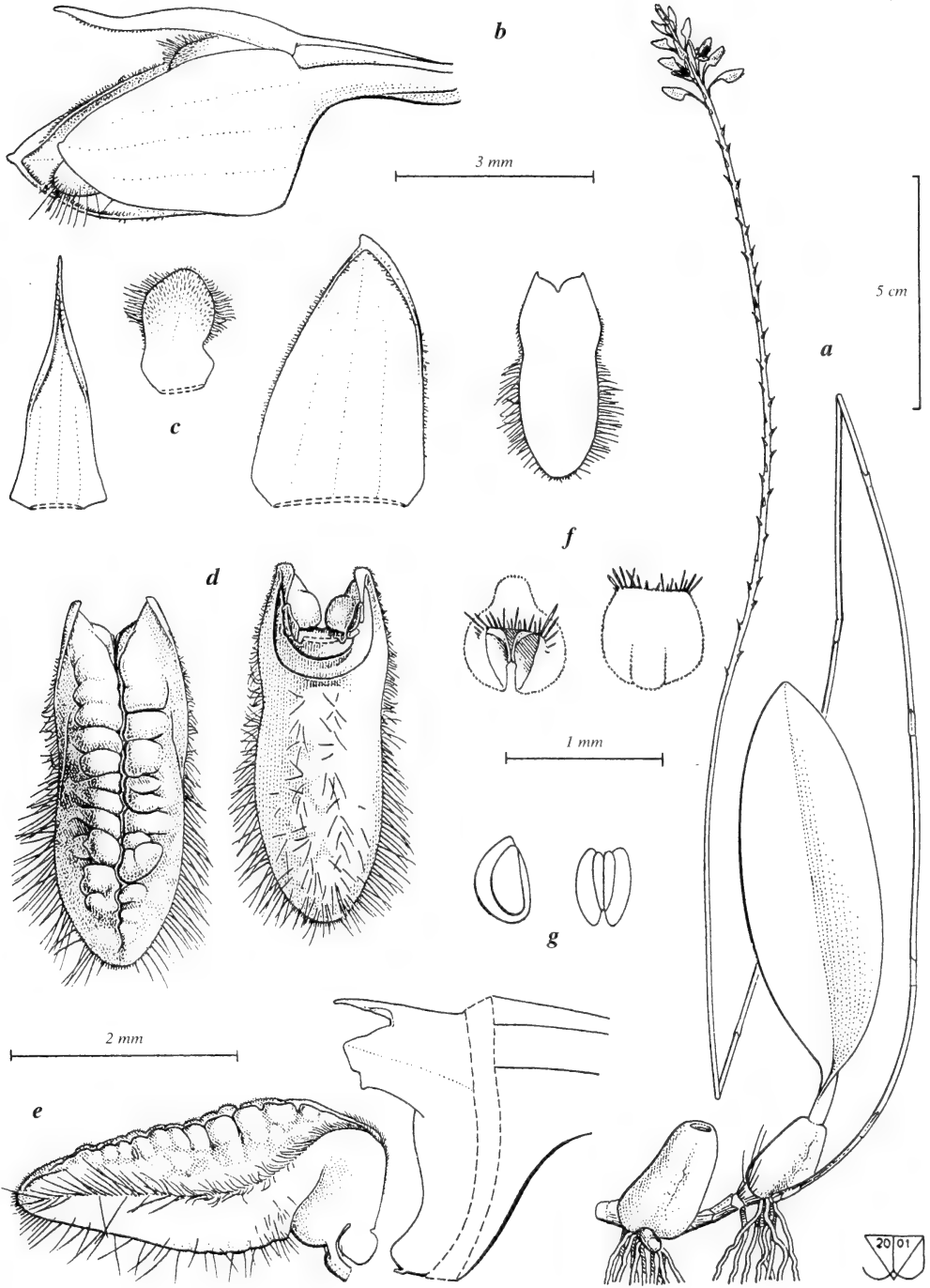


Figure 41. *Bulbophyllum ochthodes* J.J. Verm. (151)

60-flowered. *Peduncle* 19–46 cm, bracts c. 6, the longest 4.8–5.5 mm long. *Rhachis* not thickened, 6.5–12 cm long, glabrous. *Floral bracts* triangular, 1.8–2 x c. 1 mm, acute. *Flowers* not fully opening, few simultaneously. *Pedicel* and *ovary* 2.8–4 mm long, basal node on a 0.2–0.5 mm-long stump. *Median sepal* ± porrect, triangular, 3.8–4 x 1.5 mm, index 2.5–2.7; acuminate, margins ciliate, base rather narrowly attached; thick, surface glabrous. *Lateral sepals* somewhat recurved, ovate, 4.5–5 x 2.8–3 mm, index c. 1.6; subacute, otherwise as the median sepal. *Petals* porrect, spatulate with a widened base, c. 2 x 1–1.1 mm, index c. 1.8; rounded, margins ciliate, base rather broadly attached; rather thin, surface hirsute towards the tip. *Lip* abruptly recurved near the base, elliptic-oblong, 3–3.1 x 1.2–1.5 mm, index 2–2.6; rounded, margins densely ciliate with the hairs thicker and ± stiff towards the tip; very thick; adaxially concave near the base, with a median slit over most of its length, with 2 rows of irregularly shaped, fleshy, finely and shortly hirsute calli, adaxial surface otherwise ± glabrous; abaxially with a rounded ridge near the base, surface otherwise convex with scattered, slightly stiff, thick hairs more or less arranged in two rows, surface otherwise glabrous. *Column* 1.2–1.3 mm long, stigma with an inconspicuous, slightly cleft basal callus, column foot swollen. *Stelidia* deltoid, c. 0.4 mm long, obtuse, with a small, deltoid, obtuse teeth along the lower margin. *Anther*: front margin ciliate, abaxial ridge papillose.

Colours: Peduncle dark red. Sepals reddish purple, pale yellowish green near the base, cilia along the margins white. Petals whitish near the base, blackish purple towards the tip, hairs blackish purple. Lip blackish purple except for a pale yellowish patch near the base abaxially, and the yellowish furrows between the warts adaxially. Column yellowish.

Habitat & ecology: Montane forest. Alt. c. 1500 m.

Distribution: MALAYSIA: Peninsula (1 specimen seen).

Notes: Most similar to *Bulbophyllum polygaliflorum*, but differs in the flowers having a shorter lip with only two rows of calli adaxially.

Only a single specimen is known, from a nursery in Cameron Highlands, Malaysia, which was said to have been collected locally.

Figure 42. *Bulbophyllum phreatiops* J.J. Verm. (152) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, above: adaxial side, below: abaxial side; e. Column and lip, lateral view; f. Anther, left: adaxial side, right: abaxial side; g. Pollinia, above: single pair, below: two pairs. – All from *Hoogland & Craven 10899* (herbarium specimen).

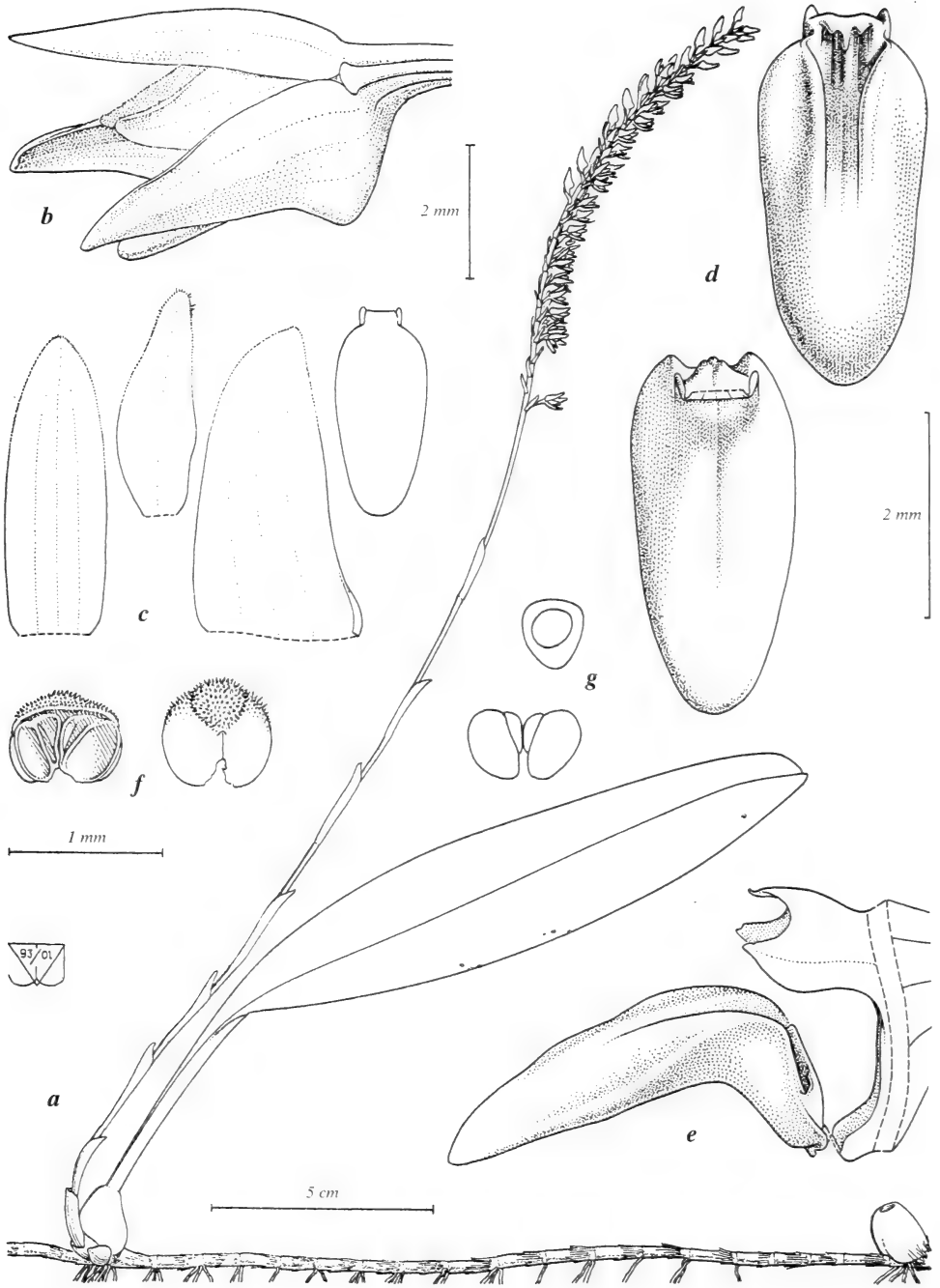


Figure 42. *Bulbophyllum phreatiense* J.J. Verm. (152)

152. *Bulbophyllum phreatiopse* J.J. Verm. – Fig. 42.

Bulbophyllum phreatiopse J.J. Verm., Blumea 38 (1993) 151. – TYPE: Papua New Guinea, East Sepik District, Mt. Hunstein, Hoogland & Craven 10899 (L. holo., AMES, LAE iso.).

Rhizome 2.5–5 mm diam., sections between pseudobulbs 4–19 cm long. *Pseudobulbs* widely distant, ovoid, 1.2–1.8 x 0.8–1.2 cm. *Petiole* 3–5.5 cm. *Leaf blade* elliptic, 10–13.5 x 2–3.3 cm, index (length/width) 4.5–5.5; obtuse. *Inflorescence* an elongated, dense raceme, erect to patent, 27–35 cm, 40–55-flowered. *Peduncle* 18–26 cm, bracts 8–11, the longest 15–25 mm long. *Rhachis* not thickened, 7–13 cm long, glabrous. *Floral bracts* ovate, 2.5–5 x c. 2 mm, acute. *Flowers* secund, not fully opening, many simultaneously. *Pedicel* and *ovary* 1.8–3 mm long, basal node c. flush with the surface of the rhachis. *Median sepal* porrect, ovate to elliptic, c. 4.6–5.2 x 1.8–2 mm, index 2.5–3; obtuse to subacute, margins and adaxial surface finely papillose distally, base broadly attached; rather thin. *Lateral sepals* recurved, ovate, 5–5.5 x 2.5–3 mm, index 1.8–2, acute; otherwise as the median sepal. *Petals* porrect, ovate, 3–3.8 x 1.2–1.5 mm, index c. 2.5; obtuse, margins and adaxial surface papillose distally, base rather narrowly attached; rather thin. *Lip* recurved in the proximal half, ovate, 3–3.5 x 1–1.5 mm, index 2.3–3; rounded, thick, glabrous; adaxially concave near the base, and with a median ridge with a tooth on its crest and flanked by furrows, this median ridge proximally widening to a triangular callus forming a roof over the flanking furrows, in front of the median ridge two more ridges converging distally, adaxial surface distally convex; abaxially with a wide, retuse ridge towards the base. *Column* 1.5–1.8 mm long. *Stelidia* triangular, 0.6–0.9 mm long, tip acute; with or without a small, deltoid, obtuse tooth along the upper margin. *Anther*: front margin and abaxial ridge papillose.

Colours: Sepals and petals white. Lip white, or orange-yellow.

Habitat & ecology: Epiphyte in primary forest. Alt. 1300–1500 m. Flowering in Oct–Nov.

Distribution: PAPUA NEW GUINEA: East Sepik Dist., Southern Highlands District (2 specimens seen).

Notes: *Bulbophyllum phreatiopse* is tentatively included in sect. *Hirtula*, see the note below the description of the section.

Figure 43. *Bulbophyllum parviflorum* Par. & Rchb.f. in Rchb.f. (153) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Lip, adaxial side; f. Column and lip, lateral view; g. Anther, left: adaxial side, right: abaxial side; h. Pollinia, above: single pair, below: two pairs. – a. From Pantling 245 (herbarium specimen); b–d, f–h. From Hort. Leiden 960104 (spirit sample); e. From GT 8549 (spirit sample).

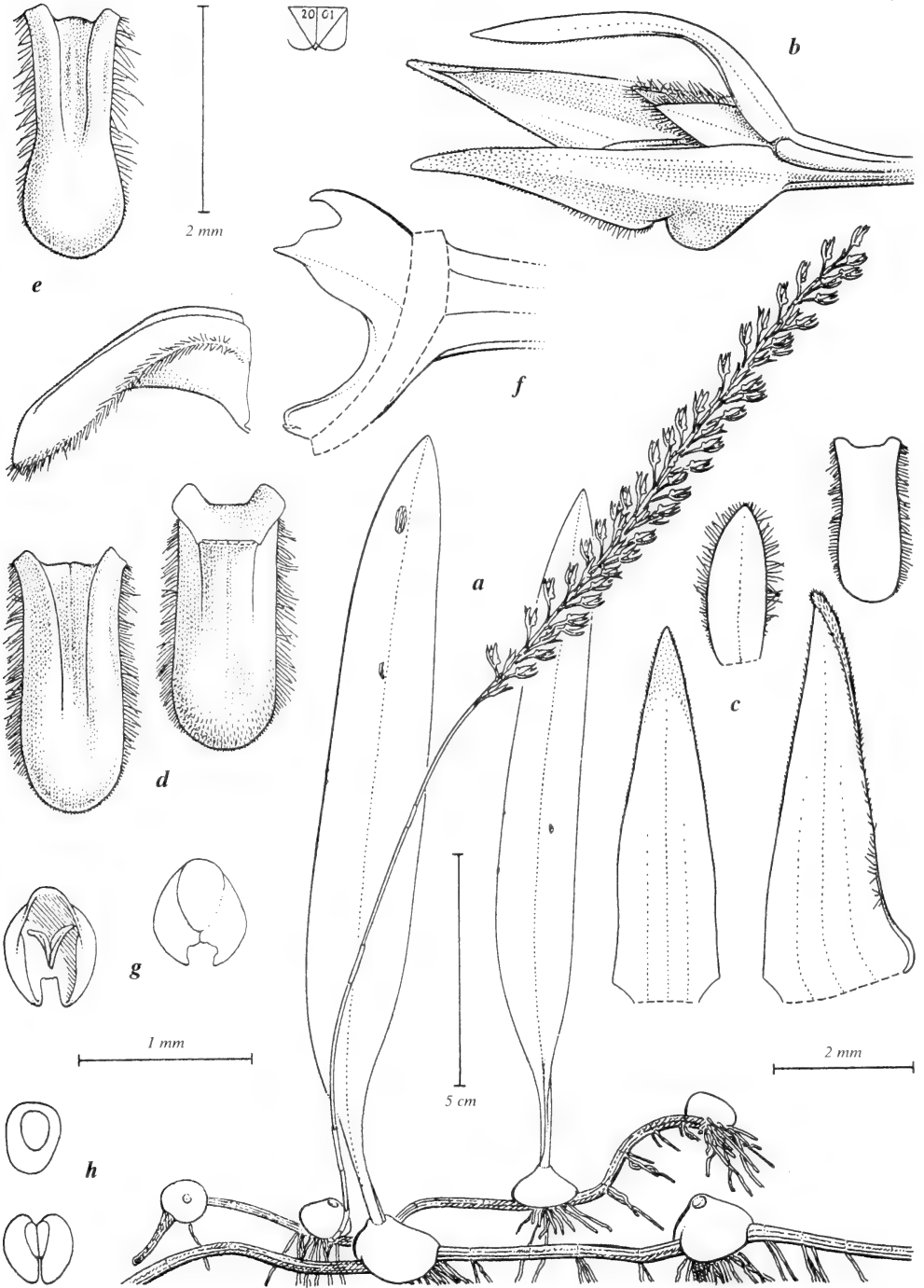


Figure 43. *Bulbophyllum parviflorum* Par. & Rchb.f. in Rchb.f. (153)

The original description of *B. phreatiopse* erroneously stated that the petals are 3-veined.

153. *Bulbophyllum parviflorum* Par. & Rchb.f. in Rchb.f. – Fig. 43, plate 33.

Bulbophyllum parviflorum Par. & Rchb.f. in Rchb.f., Trans. Linn. Soc. London, Bot. 30 (1874) 152. – *Phyllorchis parviflora* (Par. & Rchb.f. in Rchb.f.) O. Kuntze, Rev. Gen. Pl. 2 (1891) 677. — TYPE: Myanmar, Tenasserim, *Parish 305* (K, holo.; C, W, iso.).

Bulbophyllum thomsoni Hook.f., Fl. Brit. Ind. 5 (1890) 764; id., Hooker's Icon. Pl. 21 (1892) t. 2041; King & Pantling, Ann. Roy. Bot. Gard. (Calcutta) 8 (1898) 83, t. 116. – *Phyllorchis thomsonii* (Par. & Rchb.f. in Rchb.f.) O. Kuntze, Rev. Gen. Pl. 2 (1891) 678. — TYPE: Sikkim, *Thomson s.n. (1850)* (K, holo.).

Rhizome 2.8–5 mm diam., sections between pseudobulbs 2–10 cm long. *Pseudobulbs* widely distant, depressed conical, 0.8–2 x 1.2–1.8 cm. *Petiole* 1–3 cm. *Leaf blade* ovate, 7.2–16 x 1.2–2.4 cm, index (length/width) 5.4–7.9; obtuse to acute. *Inflorescence* an elongated, dense raceme, erect to patent, 15–30 cm, 35–80-flowered. *Peduncle* 6–12 cm, bracts c. 6, the longest 9–14 mm long. *Rhachis* not thickened, 9.5–19.5 cm long, glabrous. *Floral bracts* ovate to triangular, 1.3–4 x 1–2 mm, acuminate. *Flowers* sometimes secund, not fully opening, many simultaneously. *Pedicele* and *ovary* 2.2–4 mm long, basal node ± flush with the surface of the rhachis or on a c. 0.2 mm-long stump. *Median sepal* porrect, triangular, 2.8–6 x 0.8–1.7 mm, index 2.4–3.8; acute, margins ciliolate, base rather broadly attached; rather thin, surface very finely papillose locally. *Lateral sepals* slightly recurved, 2.8–6.5 x 1.1–2.5 mm, index 1.5–3.2, upper margin glabrous to ciliolate, lower margin ciliolate to ciliate; otherwise as the median sepal. *Petals* porrect, (ob-)ovate to elliptic, 1.5–2.4 x 0.6–1 mm, index 1.8–3; obtuse to acuminate, margins ciliate, base rather broadly attached; thin, glabrous. *Lip* recurved in the proximal half, oblong to subspathulate, 1.7–2.5 x 0.8–1 mm, index 1.8–2.5; rounded, margins ciliate except near the tip; thick, surface finely papillose, or only so distally; adaxially concave near the base, without a basal callus, with 2–3 ridges, the lateral distinct, rather sharp, diverging proximally and continuing over c. 2/3 of the lip, the median ridge, if present, low, inconspicuous, rounded and continuing over 1/2 of the lip; abaxially with a wide, retuse ridge towards the base; basal auricles inconspicuous. *Column* 1–1.3 mm long. *Stelidia* triangular, 0.4–0.7 mm long, tip obtuse; with a deltoid, rounded to obtuse tooth along the upper margin, and often an inconspicuous, rounded wing along the lower margin, at the base. *Anther*: front margin glabrous, abaxial surface somewhat finely papillose.

Colours: Sepals and petals creamy white, the petals sometimes with red cilia. Lip white, yellow or green.

Habitat & ecology: Tropical forest. Alt. 400-1500 m. Flowering in Jul—Oct.

Distribution: BHUTAN (1). INDIA: Sikkim (3 specimens seen). MYANMAR: Moulmein (1). THAILAND (2).

Notes: The flower colour is partly copied from King & Pantling (1898).

On average, the Myanmar and Thailand specimens (including the type of *Bulbophyllum parviflorum*) are smaller in all parts than those from the eastern Himalayas (including the type of *B. thomsoni*). As far as can be ascertained from herbarium material, they also have a more distinct median ridge on the adaxial side of the lip. Distinction of subspecies, however, is impossible with the material now available.

154. *Bulbophyllum secundum* Hook.f. – Fig. 44, plate 34, 35.

Bulbophyllum secundum Hook.f., Fl. Brit. Ind. 5 (1890) 764; id., Hooker's Icon. Pl. 21 (1892) t. 2042; Seidenf., Dansk Bot. Ark. 33, 3 (1979) 103 (partly, excl. syn. *B. nigripetalum* [is *B. nigripetalum*]). – *Phyllorchis secunda* (Hook.f.) O. Kuntze, Rev. Gen. Pl. 2 (1891) 678. – TYPE: India, Naga Hills, *Prain 41* (K, holo.).

Bulbophyllum subparviflorum Z.H. Tsi & S.C. Chen, Acta Phytotax. Sin. 32 (1994) 555. – TYPE: China, Yunnan, Menghai, *Tsi 91-544* (PE, holo.; K, iso.)

Rhizome 0.8—1.2 mm diam., sections between pseudobulbs 0.5—1.8 cm long. *Pseudobulbs* close, depressed conical to lenticular, 0.4—1 x 0.6—1.5 cm. *Petiole* 0.7—1.5 cm. *Leaf blade* elliptic, 3.2—10 x 0.4—1 cm, index (length/width) 5—12.5; obtuse to acute. *Inflorescence* an elongated, rather lax raceme, erect, 7.5—22 cm, 8—23-flowered. *Peduncle* 5—13.2 cm, bracts c. 4, the longest 2—4.5 mm long. *Rhachis* not thickened, 2.2—11 cm long, glabrous. *Floral bracts* triangular, 1—1.8 x 0.8—1.2 mm, acute to acuminate. *Flowers* distichous or scattered, resupinate, secund, not fully opening, several simultaneously. *Pedicel* and *ovary* 1.8—6 mm long, basal node \pm flush with the surface of the rhachis or on a c. 0.3 mm-long stump. *Median sepal* \pm porrect, ovate to triangular, 2—3.2 x 0.9—1.3 mm, index 2.1—2.5; obtuse to acute, margins ciliate, base rather narrowly attached; rather thin, surface glabrous. *Lateral sepals* recurved, triangular, 2.2—3.8 x 1.3—2.2 mm, index 1.4—1.9; (sub-)acute, upper margin glabrous to sparsely ciliate; otherwise as the median sepal. *Petals* porrect, obovate to spatulate, 1.5—2.2 x 0.6—0.8 mm, index 2.2—3; rounded to obtuse, margins ciliate, base broadly attached; thin, glabrous or slightly papillose towards the tip. *Lip* recurved in the proximal half, ovate, 1.8—3 x 0.9—1.2 mm, index 1.8—2.8; rounded, margins ciliate except near the tip; thick; adaxially slightly concave near the base and with a deeply cleft, triangular basal callus, with 2 very weak, rounded ridges diverging proximally and fused to a single slightly convex body in the distal half of the lip, surface finely papillose to shortly pubescent proximally and glabrous distally; abaxially with an inconspicuous, retuse

ridge towards the base, surface glabrous. *Column* 1.1—1.3 mm long. *Stelidia* triangular, 0.3—0.5 mm long, tip acute: with or without an often antrorse, deltoid to triangular, obtuse to acute tooth along the upper margin, with or without a deltoid, rounded to obtuse wing along the lower margin, at the base. *Anther*: front margin papillose, abaxial surface papillose distally.

Colours: Sepals pale green, often suffused with dull reddish brown or purple towards the tip, or almost entirely of that colour except for the base. Petals pale green, similarly suffused with reddish brown or purple: hairs purple. Lip reddish purple, or brownish green, proximally dark brown along the margins. Column greenish, often dark brownish or purplish at the foot. Flowers also reported to be light blue (unlikely, see *Samuel 13549*) or pink (*Grey-Wilson & Phillips 93*).

Habitat & ecology: Epiphyte in montane temperate or tropical evergreen (shrub) forests: also reported from depleted evergreen forest. Alt. 1200-2500 m. Flowering in Jan, Feb, May—Jul, Sep.

Distribution: CHINA: Yunnan (1 specimen seen). NEPAL (2). INDIA: Sikkim (1): Assam (1): Naga Hills (1). MYANMAR: (1): northern part (2). THAILAND (4). VIETNAM: southern part (1).

Notes: Seidenfaden (1979) has confused this with *Bulbophyllum nigripetalum*; see the note under the latter.

155. *Bulbophyllum debrincatae* J.J. Verm., sp. nov. – Fig. 45, plate 36.

Bulbophyllum debrincatae J.J. Verm., a *Bulbophyllum piloso* in calcari brevi e sepalorum lateralium basi protrudenti, labelli parte apicali pilis longis differt. – TYPE: Philippines, Luzon, Nueva Viscaya, *Debrincat*, *B. cult.* (leg. Cootes, J.E.) 001 (SING. holo.).

Rhizome 3—4 mm diam., sections between pseudobulbs 1.2—1.6 cm long. *Pseudobulbs* close, ovoid, 1.3—2.5 x 1—1.6 cm. *Petiole* 2—3.5 cm. *Leaf blade* ovate-elliptic, 9.2—14.5 x 3.3—5 cm, index (length/width) 2.7—2.9; rounded. *Inflorescence* an elongated, rather dense raceme, erect, c. 43 cm, c. 34-flowered. *Peduncle* c. 24.5 cm, bracts c. 5 (4 present on portion of inflorescence available), the longest c. 10 mm long. *Rhachis* slightly thickened, c. 15 x 0.3 cm, finely papillose. *Floral bracts* triangular, c. 2.2 x 1.2 mm, acute to acuminate. *Flowers* secund, not fully opening, several simultaneously, anthesis from the top of the rhachis downwards. *Pedicle* and *ovary* c. 5.5 mm long, finely papillose distally, basal node ± flush with

Figure 44. *Bulbophyllum secundum* Hook.f. (154) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, above: abaxial side, below: adaxial side; g. Pollinia, above: single pair, below: two pairs. – a. From *Jongejan s.n.* (living plant); b—g. From *Jongejan cult.* 889 (spirit sample).

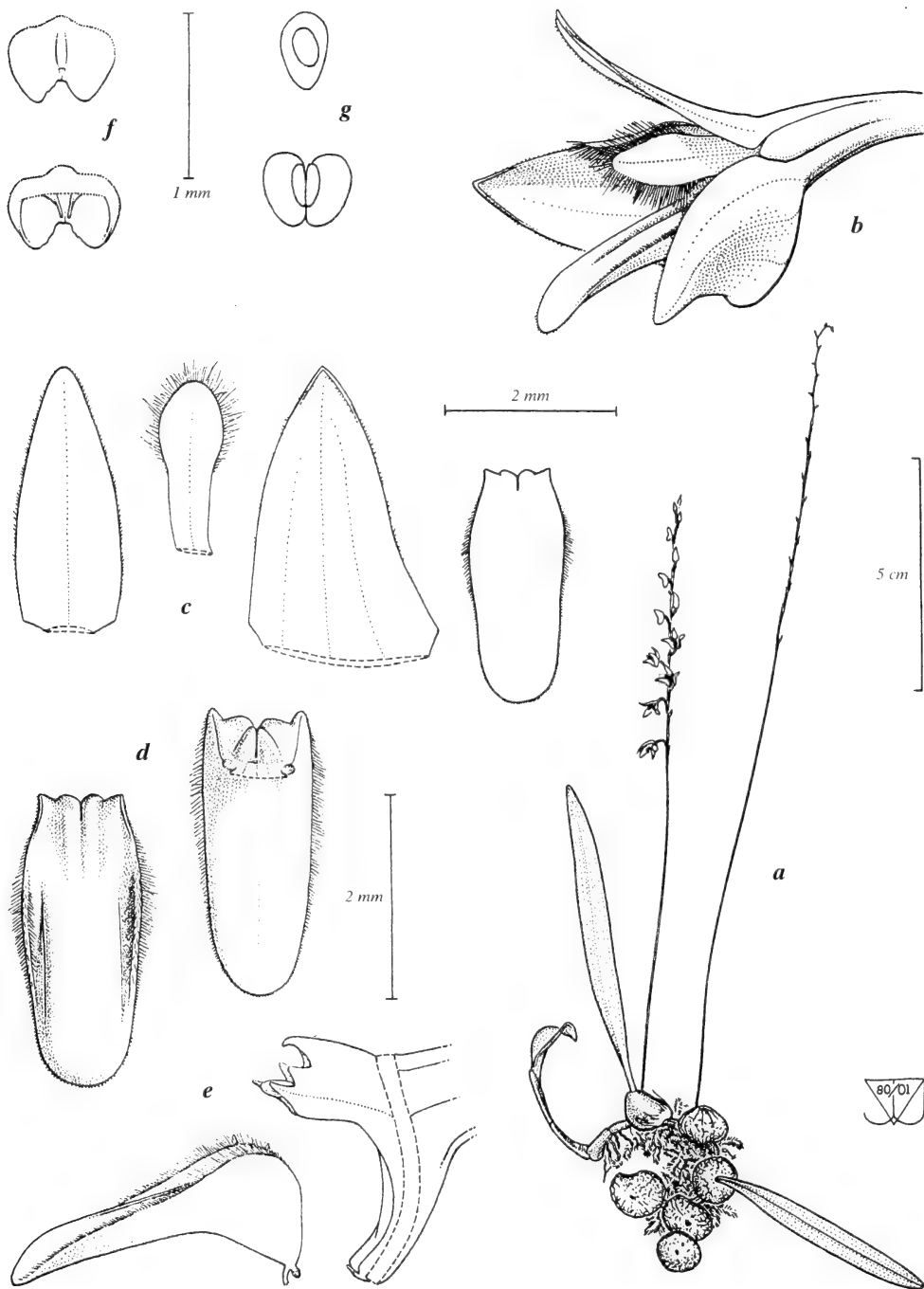


Figure 44. *Bulbophyllum secundum* Hook.f. (154)

the surface of the rhachis. *Median sepal* porrect to recurved, ovate-triangular, c. 7.5 x 2.2 mm, index c. 3.4; acute, margins ciliate, base rather broadly attached; rather thick, surface glabrous adaxially, finely papillose abaxially. *Lateral sepals* recurved, triangular, c. 7.5 x 3.6 mm, index c.2.1, upper margin ciliolate with scattered longer hairs in between; otherwise as the median sepal. *Petals* porrect, triangular-ovate, c. 3.4 x 1.4 mm, index 2.4—2.5; subacute, margins long ciliate, hairs longer towards the tip, base rather broadly attached; rather thin, surface glabrous. *Lip* curved close to the base, oblong, c. 7.5 x 2 mm, index 3.7—3.8; rounded, margins ciliolate proximally, long ciliate distally, glabrous in between; thick; adaxially slightly concave near the base, without a basal callus, with a median furrow reaching up to c. 1/4 of the lip, slightly convex elsewhere, surface glabrous; abaxially with a rounded ridge near the base, surface slightly convex, glabrous but with a finely pubescent patch in front of the basal ridge. *Column* c. 1.8 mm long, foot slightly swollen, abaxial side with a short, obtuse spur near the tip. *Stelidia* c. 0.8 mm long, acute, obliquely. rectangular in outline with a distinct, antrorse, triangular, acute tooth along the upper margin, and a similar, but obtuse tooth along the lower. *Anther*: front margin pilose, abaxial surface finely papillose.

Colours: Rhachis yellowish, slightly suffused with red. Bract, pedicel and ovary yellowish green, marked brownish red distally. Sepals yellowish green, marked with dark red (appearing almost black) along veins and margins; hairs around edge greyish. Petals similarly coloured, hairs blackish. Lip shiny black, hairs greyish. Column green with black blotches.

Habitat & ecology: Epiphyte in montane forest. Alt. c. 1200 m. Flowering in cultivation in Oct.

Distribution: PHILIPPINES: Luzon, Nueva Viscaya (1 specimen seen).

Notes: *Bulbophyllum debrincatae* is most similar to *B. pilosum*, but differs in having triangular-ovate petals, glabrous margins along the middle section of the lip, and a remarkable, small, obtuse papillose spur protruding from between the base of the lateral sepals.

Named in honour of Mrs Bev Debrincat, who acquired the plant, as part of Mr Jim Cootes's orchid collection from the Philippines in 1998, and who was the first to flower it in cultivation.

Figure 45. *Bulbophyllum debrincatae* J.J. Verm. (155) — a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, above: adaxial side, below: abaxial side; g. Pollinia, left: single pair; right: two pairs. — All from *Debrincat, B. cult. (leg. Cootes, J.E.) 001* (Photographs, notes from J. Cootes, spirit sample).

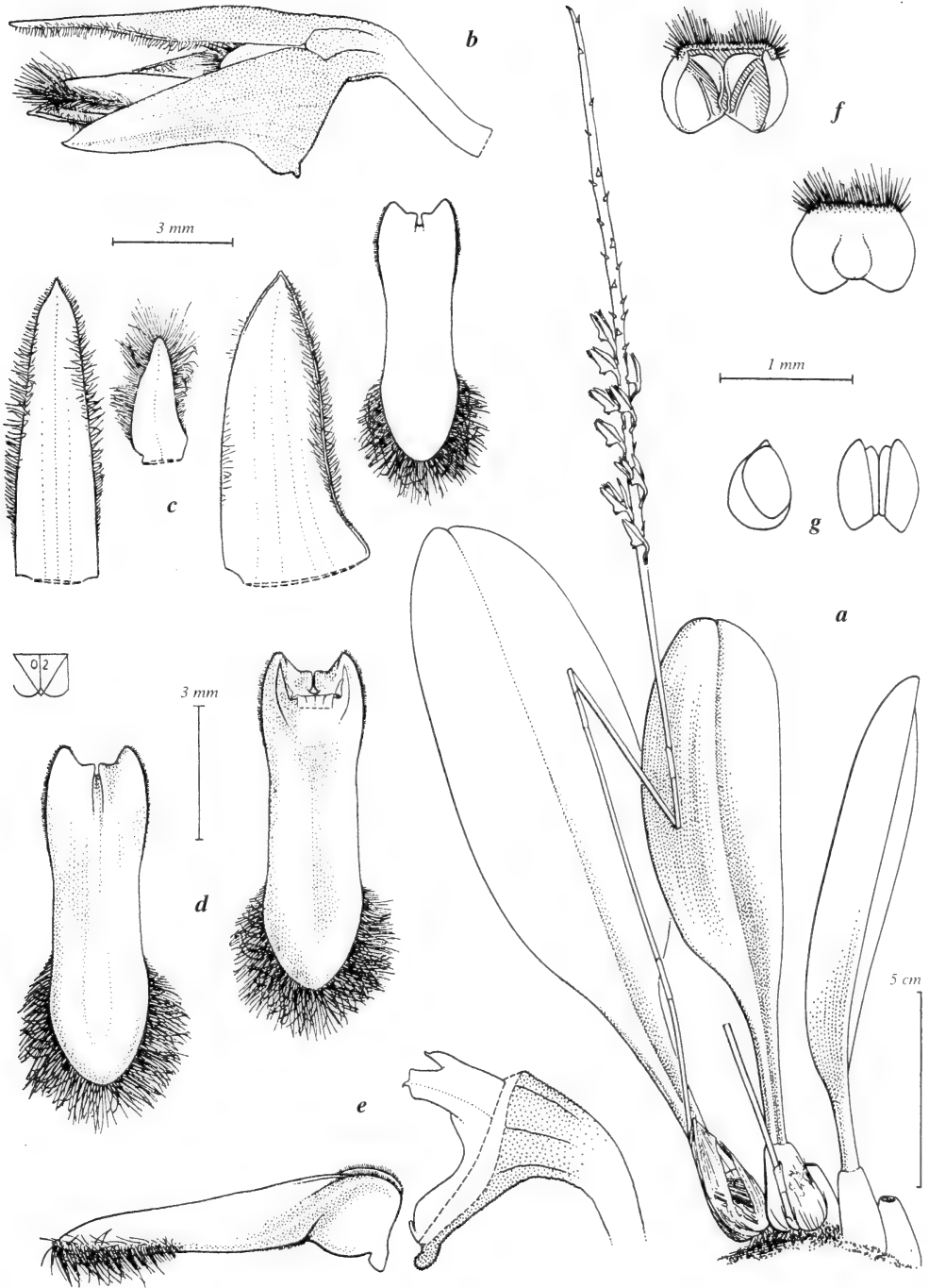


Figure 45. *Bulbophyllum deprincatae* J.J. Verm. (155)

156. *Bulbophyllum pilosum* J.J. Verm., sp. nov. – Fig. 46.

Bulbophyllum pilosum J.J. Verm., a *Bulbophyllo lasioglossa* in sepalis lateralibus ciliatis, stigmatibus basi sine callo bifido differt. – TYPE: Malaysia, Sabah, Ulu Padas, Vermeulen 562 (L, holo.).

Rhizome 1.5–2 mm diam., sections between pseudobulbs 0.4–0.7 cm long. *Pseudobulbs* touching, ovoid, 1.4–2.5 x 0.6–0.9 cm. *Petiole* 2–3.2 cm. *Leaf blade* elliptic to ovate, 11–13 x 2–2.5 cm, index (length/width) 5.2–5.8; acute. *Inflorescence* an elongated, rather dense raceme, c. 19 cm, c. 10-flowered. *Peduncle* ± patent, c. 17 cm, bracts c. 5, the longest c. 4 mm long. *Rhachis* not thickened, nodding, c. 2 cm long, glabrous. *Floral bracts* triangular, c. 1.6 x 1 mm, acuminate. *Pedicel* and *ovary* c. 6 mm long, basal node on a c. 0.2 mm-long stump. *Median sepal* porrect to ?recurved, triangular, c. 5.8 x 2.1 mm, index 2.3–2.4; acute-acuminate, margins with long hairs, base rather broadly attached; rather thin, surface glabrous. *Lateral sepals* ?recurved, ovate, c. 7.3 x 3.1 mm, index 2.3–2.4; subacute, otherwise as the median sepal. *Petals* porrect, obovate, c. 3.3 x 1.8 mm, index 1.8–1.9; rounded, margins long ciliate, hairs longer towards the tip, base rather broadly attached; rather thick, surface glabrous. *Lip* curved in the proximal half, obscurely 3-lobed; *midlobe* ovate, c. 4.2 x 1.8 mm, index 2.3–2.4; rounded, margins with long, thin, wavy hairs; rather thin with a thick base, surface glabrous; adaxially concave near the base, without a basal callus, with a median slit reaching up to 1/2 of the lip, with two obtuse ridges diverging proximally towards the distal end of the lateral lobes, distally thick and together forming a small callus continuing over c. 1/4 of the lip, surface otherwise ± flat; abaxially with a wide, retuse ridge near the base; *lateral lobes* attached along the proximal 1/4–1/5 of the lip, erect, semi-circular, margins ciliate, broadly attached, rather thin, surface glabrous. *Column* c. 1.5 mm long, foot slightly swollen. *Stelidia* c. 1 mm long, acute; obliquely rectangular in outline with a distinct, antrorse, triangular, acute tooth along the upper and lower margin.

Colours: Perianth on top of a fruit purplish.

Habitat & ecology: Understorey epiphyte in tall forest on leached sandstone soil. Alt. 1300–1500 m. Fruiting in Oct.

Distribution: MALAYSIA. Sabah, Ulu Padas (1 specimen seen).

Notes: The floral details have been reconstructed from the perianth persistent on an almost mature fruit. Some details may be inaccurate.

Most similar to *Bulbophyllum lasioglossum*; the latter differs in having

Figure 46. *Bulbophyllum pilosum* J.J. Verm. (156) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view. – All from Vermeulen 562 (herbarium specimen).

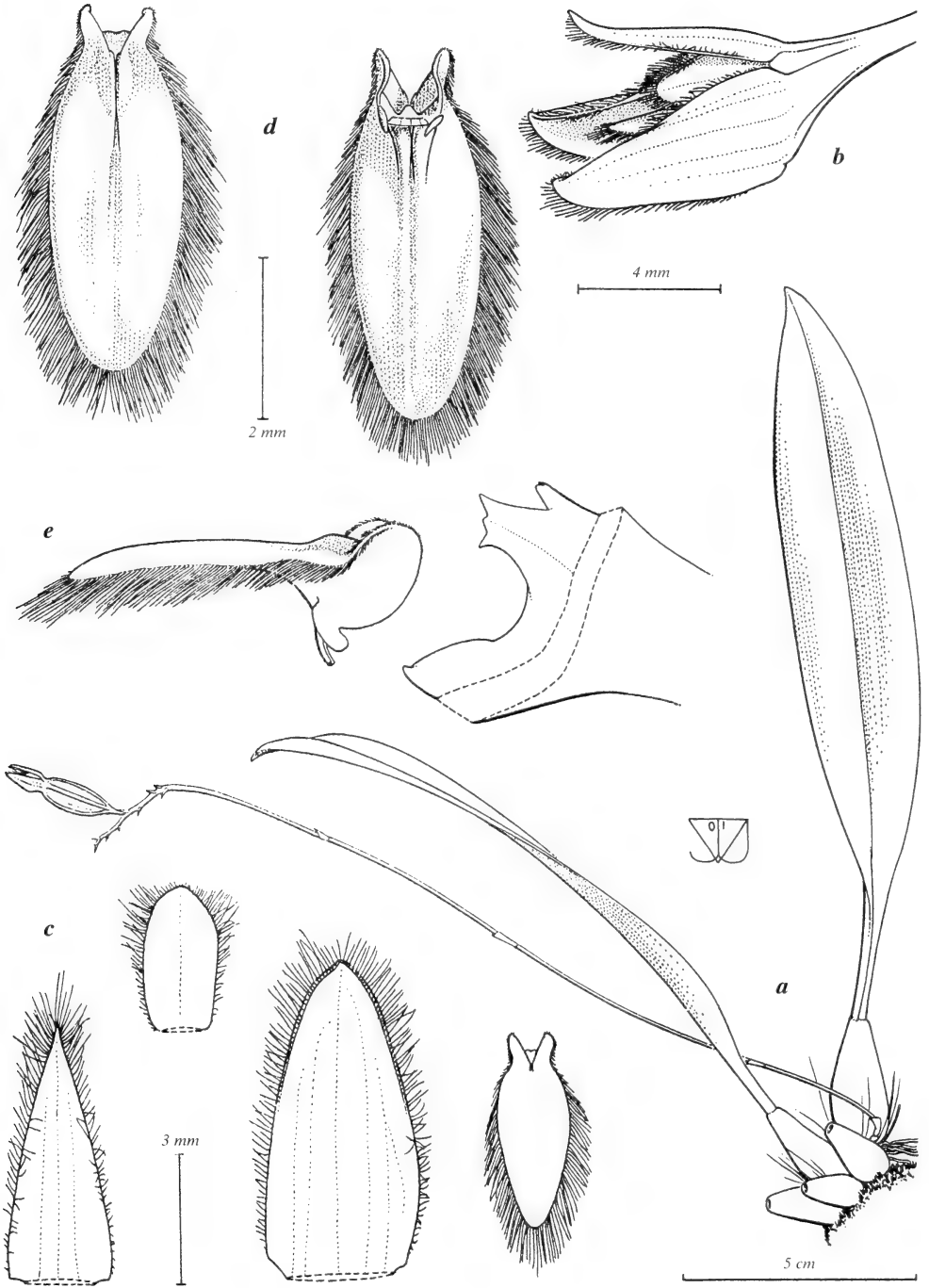


Figure 46. *Bulbophyllum pilosum* J.J. Verm. (156)

lateral sepals with glabrous margins, much narrower, acute petals, and a deeply bifid callus at the base of the stigma.

The name refers to the pilose sepals.

157. *Bulbophyllum xenosum* J.J. Verm. – Fig. 47, plate 37.

Bulbophyllum xenosum J.J. Verm., Blumea 41 (1996) 353. – TYPE: Brunei, Temburong, upper zone of Bukit Belalong, *Jongejan cult.* 4425 (L, holo.).

Rhizome 2.5–3 mm diam., sections between pseudobulbs 1.5–4.5 cm long. *Pseudobulbs* distant, depressed-conical to lenticular, 1.2–1.7 x 1–1.4 cm. *Petiole* 1.2–2 cm. *Leaf blade* elliptic, 8.5–13 x 0.8–1.2 cm, index (length/width) 10–11; subacute. *Inflorescence* an elongated, lax raceme, c. 44 cm, c. 30-flowered. *Peduncle* patent, c. 19 cm, bracts c. 4, the longest 5 mm long. *Rhachis* not thickened, arching, c. 25 cm long, glabrous. *Floral bracts* triangular, 2–2.5 x c. 1 mm, acute. *Flowers* imperfectly distichous but scattered at the base and the tip of the rhachis, secund, many open simultaneously, fully open. *Pedicel* and *ovary* 4.5–5 mm long, basal node on a c. 0.3 mm-long stump. *Median sepal* porrect to recurved, ovate, c. 11 x 1.5 mm, index 7–8; acute, margins ciliate, base rather broadly attached; rather thin, surface glabrous. *Lateral sepals* recurved, triangular, 9.5–10 x c. 2.2 mm, index 4.3–4.6; upper margin glabrous, base broadly attached; otherwise as the median sepal. *Petals* porrect, obovate, c. 1.5 x 0.8 mm, index 1.8–1.9; acute, margins long ciliate towards the tip, base broadly attached; thin, surface glabrous. *Lip* curved near the base, ovate-triangular, c. 5.5 x 1.5 mm, index 2.6–2.7; obtuse, margins slightly erose, with long, straight, rather thin hairs increasing in length and thickness towards the tip of the lip; lip rather thin, base thick; adaxially slightly concave near the base, without a basal callus, with a median slit continuing over about 1/3 of the lip, surface otherwise flat or somewhat convex, glabrous; abaxially with a retuse ridge near the base, surface otherwise flat or somewhat convex, glabrous except for two longitudinal rows of hairs about half-way up the lip. *Column* c. 2.2 mm long. *Stelidia* falcate, triangular, c. 0.9 mm long, tip acute; with an inconspicuous, deltoid, acute tooth along the upper margin, and an inconspicuous, deltoid, broadly rounded wing along the lower margin. *Anther*: front margin long ciliate, abaxial ridge with hairs.

Colours: Rhachis, pedicel and ovary suffused with reddish purple.

Figure 47. *Bulbophyllum xenosum* J.J. Verm. (157) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: abaxial side, right: adaxial side; e. Column and lip, lateral view; f. Anther, above: abaxial side, below: adaxial side; g. Pollinia, left: two pairs, right: single pair. – All from *Jongejan cult.* 4425 (spirit sample).

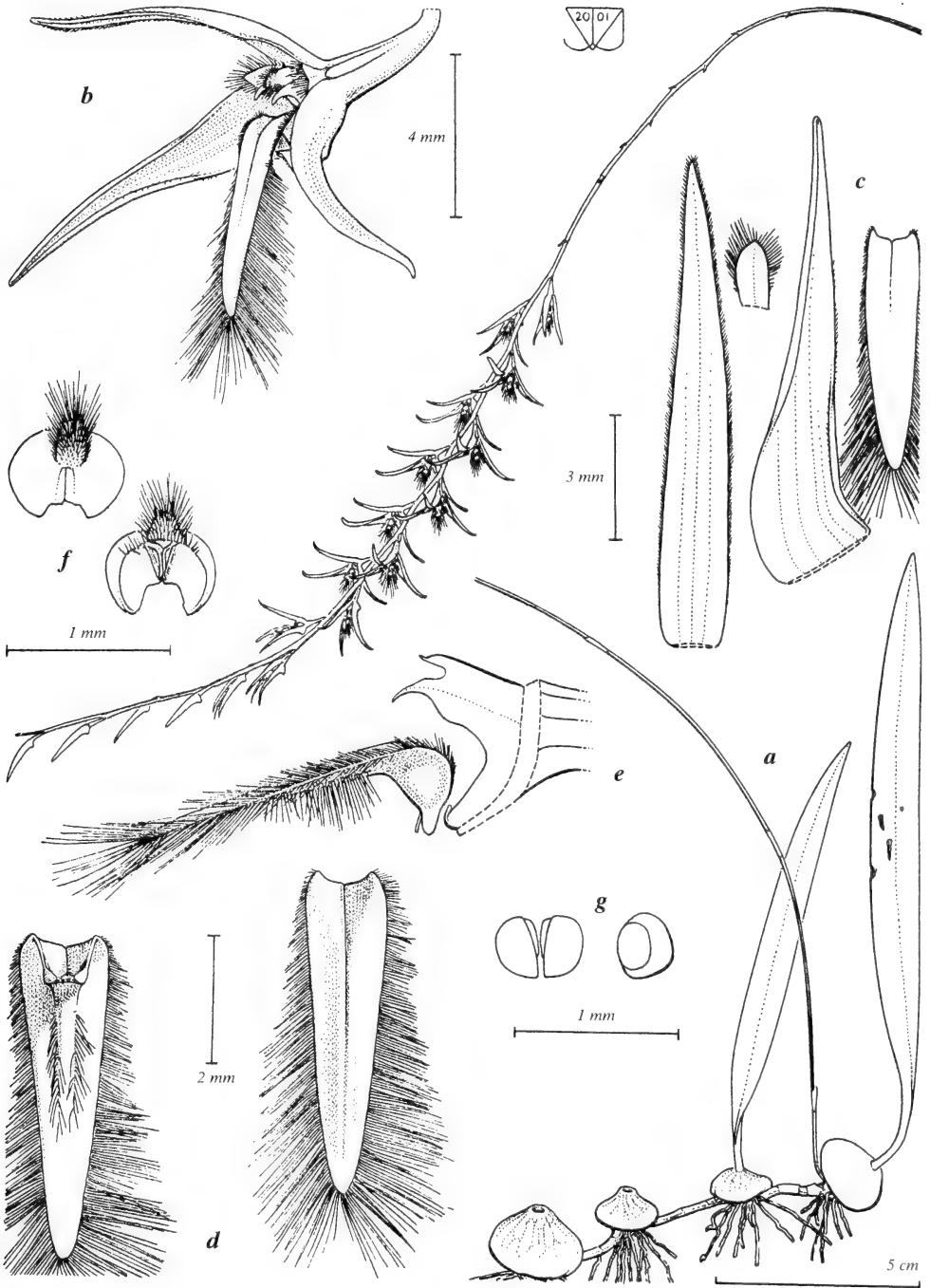


Figure 47. *Bulbophyllum xenosum* J.J. Verm. (157)

Sepals greenish white, abaxially suffused with pale purple, adaxially heavily stained with purple and with large, blackish purple blotches. Lip yellowish white, suffused with reddish purple towards the margins, and with large, more or less transverse blackish purple blotches; hairs reddish at the base, yellow towards the tip.

Habitat & ecology: Primary forest. Alt. 650—900 m.

Distribution: BRUNEI (1 specimen seen).

158. *Bulbophyllum limbatum* Lindl. – Fig. 48, plate 38.

Bulbophyllum limbatum Lindl., Edward's Bot. Reg. 26, misc. (1840) 74 ("Bolbophyllum"); J.J. Smith, Repert. Spec. Nov. Regni Veg. 32 (1932) 305; Seidenfaden, Dansk Bot. Ark. 33, 3 (1979) 100. — *Phyllorchis limbata* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2 (1891) 677. – TYPE: Singapore, *Loddiges* (K. holo.).

Bulbophyllum blepharosepalum Schltr. Bull. Herb. Boiss. s. 2, 6 (1906) 462. – TYPE: Indonesia, Sumatra, Indragiri, Sungei Lalah, *Schlechter 13241* (B. holo., destroyed).

[Not *Bulbophyllum limbatum sensu* Par. & Rchb.f. in Rchb.f., Trans. Linn. Soc. London, Bot. 30 (1874) 152 (= *B. rufilabrum* Par. ex Hook.f., sect. *Careyana*, fide Seidenfaden 1979).]

Rhizome 2—4 mm diam., sections between pseudobulbs 2—26 cm long. *Pseudobulbs* (widely) distant, ovoid to depressed-conical or lenticular, 1—2.5 x 1.2—2.5 cm. *Petiole* 1—4 cm. *Leaf blade* ovate, 7.5—16 x 2—3.7 cm, index (length/width) 3.1—5.3; acute. *Inflorescence* an elongated, rather dense raceme, erect to patent, 6.5—26 cm, 7—22-flowered. *Peduncle* 5—16.5 cm, bracts 5—6, the longest 4.5—6 mm long. *Rhachis* not thickened, 1.4—10 cm long, glabrous. *Floral bracts* triangular, not clasping the rhachis, 1.2–1.5 mm long, acute. *Flowers* scattered, secund, not opening fully, many simultaneously. *Pedicel* and *ovary* 45—6.2 mm long, basal node on a 0.2—0.4 mm-long stump. *Median sepal* porrect, ovate, 4—6.5 x 1.8—3.4 mm, index 1.5—2.6; obtuse to acute, margins ciliate, base broadly attached; rather thin, surface glabrous or finely papillose locally. *Lateral sepals* recurved, ovate-triangular, 4.8—7.5 x 2.5—5 mm, index 1.1—2.2; obtuse to acuminate, upper margin slightly papillose; otherwise as the median sepal. *Petals* porrect, elliptic to spatulate, 2.4—3.8 x 1—1.9 mm, index 1.7—2.8; rounded to obtuse, margins ciliate distally, base broadly attached; rather thin, surface finely papillose to pubescent distally, otherwise glabrous. *Lip* curved near the base, (ob-)ovate to elliptic, 3.5—6 x 1.2—3 mm, index

Figure 48. *Bulbophyllum limbatum* Lindl. (158) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: abaxial side, right: adaxial side; e. Column and lip, lateral view; f. Anther, above: adaxial side, below: abaxial side; g. Pollinia, left: two pairs, right: single pair. – a. From *Jongejan cult. 3995* (spirit sample); b—g. From *Hort. Leiden 960104a* (spirit sample).

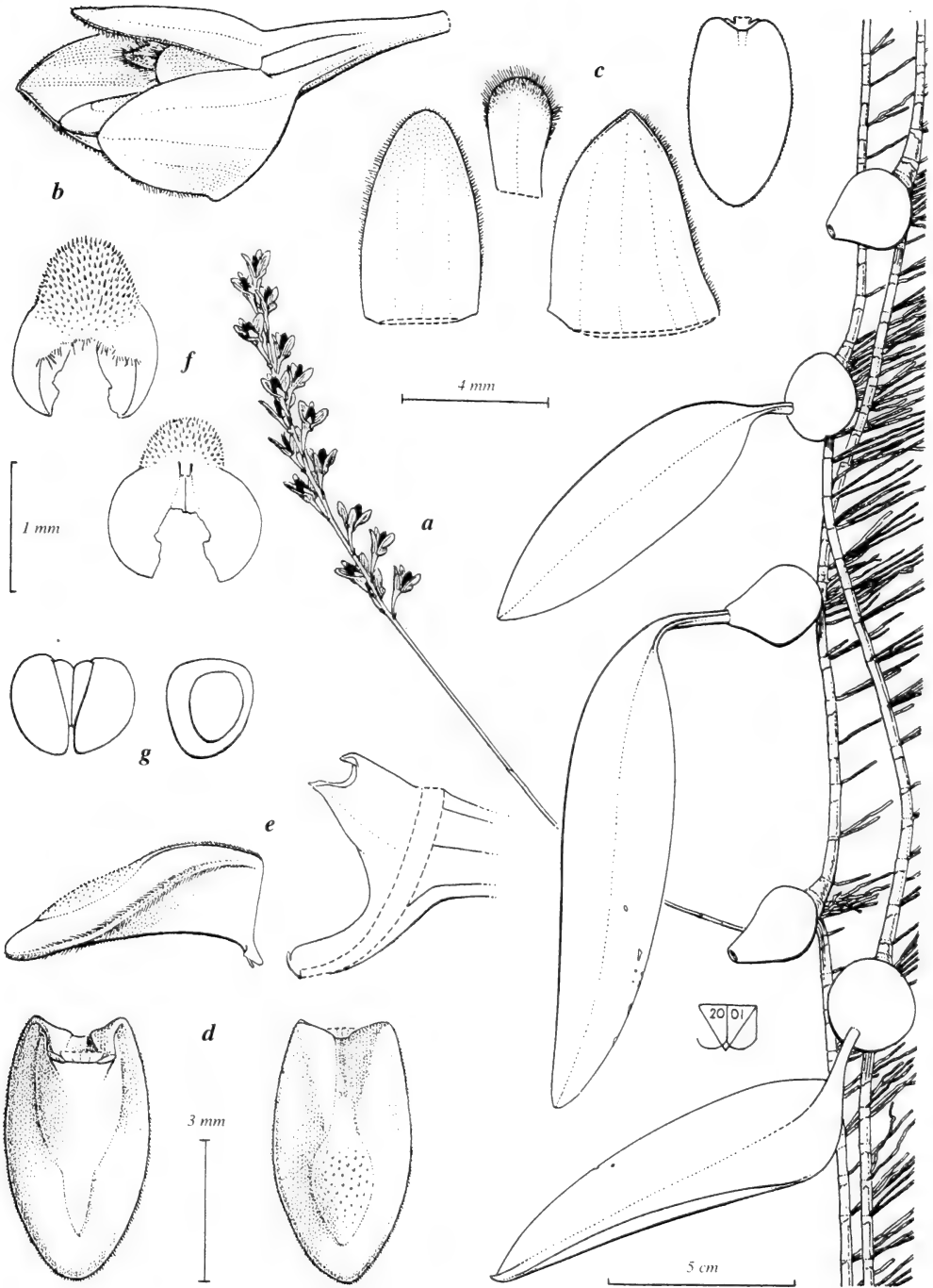


Figure 48. *Bulbophyllum limbatum* Lindl. (158)

1.6—3; rounded to obtuse, margins papillose distally; thick; adaxially slightly concave near the base, without a basal callus, with two inconspicuous, rounded, sometimes finely pubescent, proximally diverging ridges in the proximal 1/3 of the lip, with a median strip widening c. half-way up the lip into a vaguely outlined, large, somewhat convex, ovate, glabrous or papillose patch, with the surface otherwise glabrous proximally and often finely papillose or hirsute distally; abaxially with a \pm truncate ridge near the base, surface otherwise slightly concave, glabrous. *Column* 1.7—2.3 mm long, *Stelidia* triangular, 0.4—0.8 mm long; acute. *Anther*: front margin erose and fimbriate, abaxial ridge papillose.

Colours: Sepals yellowish to greenish, with reddish-purple veins and margin, proximally often with a few purplish blotches; cilia white. Petals yellowish, with a reddish purple vein and margins; proximally often with a purplish blotch. Lip bright yellow, or reddish purple, adaxially with a yellowish or whitish median line, abaxially with a yellowish to white base.

Habitat & ecology: Rainforest; also in low and open *kerangas* forest and similar forest on ultrabasic soil. Alt.: sea level to 1000 m. Flowering in Jan, Apr, Aug, Oct, Nov.

Distribution: THAILAND (*vide* Seidenfaden). MALAYSIA: Peninsula (6); Sarawak (4); Sabah (4). SINGAPORE (1). BRUNEI (1). INDONESIA: Sumatra (*vide* Schlechter); Riau Archipelago, Bangka (*vide* J.J. Smith); Kalimantan (1).

Note: The flowers are almost identical to those of the next species. The differences between the two are mainly in the vegetative parts, and the mode of anthesis.

159. *Bulbophyllum rariflorum* J.J. Sm. – Fig. 49.

Bulbophyllum rariflorum J.J. Sm., Bull. Dep. Agric. Indes Neerl. 15 (1908) 20. – TYPE: Indonesia, Kalimantan, Pontianak, *Hort. Bogor s.n.* (BO, holo., not seen).

Rhizome 1.7—2.7 mm diam., sections between pseudobulbs 0.8—9.5 cm long. *Pseudobulbs* close to widely distant, depressed-conical to lenticular, 0.7—1.2 x 1.2—1.8 cm. *Petiole* 1—2.6 cm. *Leaf blade* elliptic to ovate, 7—14 x 0.8—1.6 cm, index (length/width) 6.5—10; acute. *Inflorescence* an elongated, very lax raceme, patent, 11—41 cm, 1—9-flowered. *Peduncle* 10.6—32.5 cm, bracts 3—4, the longest 3—5 mm long. *Rhachis* not thickened, slightly arching, 0.4—9.5 cm long, glabrous. *Floral bracts* tubular,

Figure 49. *Bulbophyllum rariflorum* J.J.Sm. (159) – a. Habit; b. Flower; c. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip; d. Lip, left: adaxial side, right: abaxial side; e. Column and lip, lateral view; f. Anther, above: adaxial side, below: abaxial side; g. Pollinia, above: two pairs, below: single pair. – All from *Jongejan cult. 2214* (spirit sample).

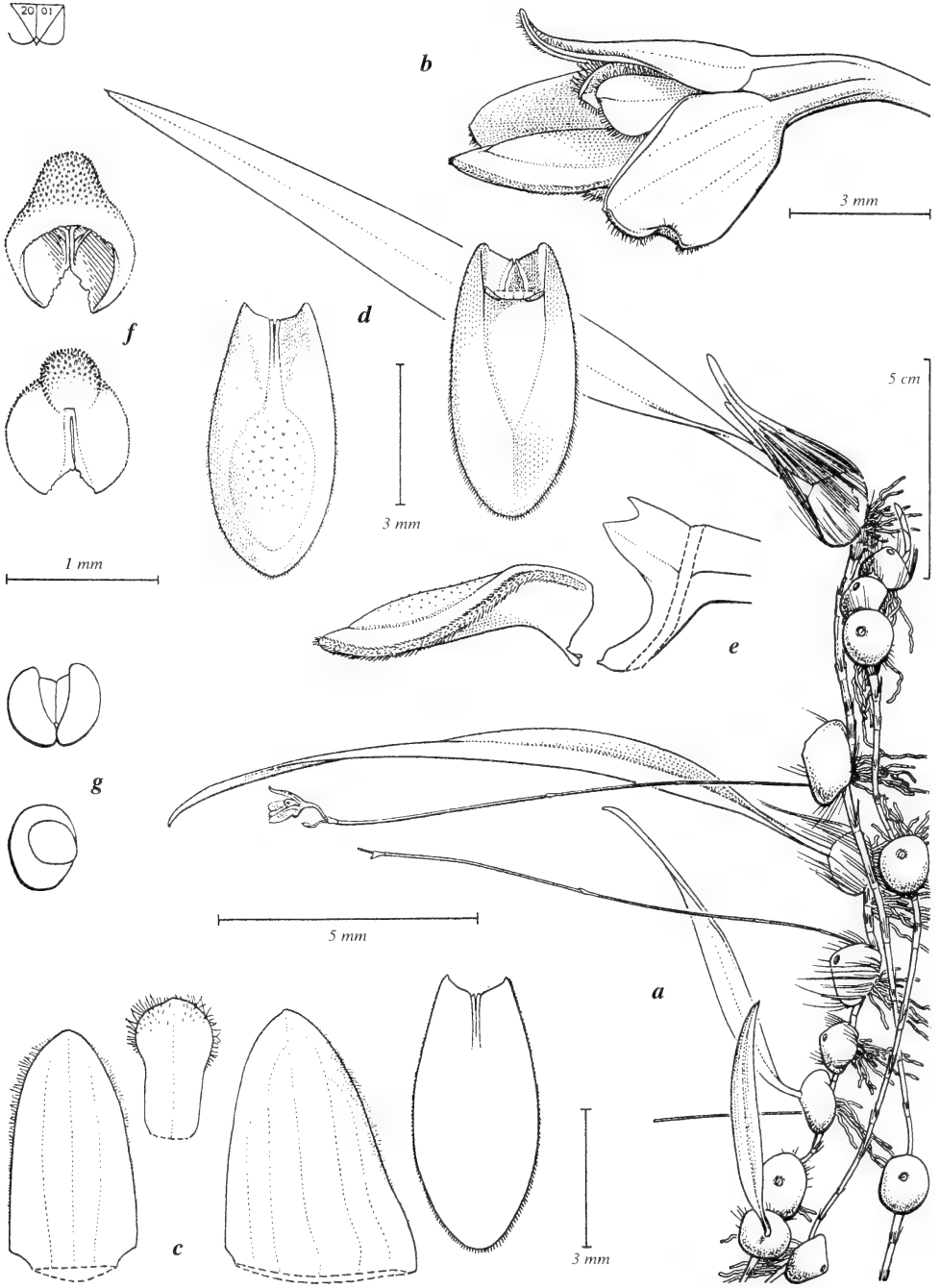


Figure 49. *Bulbophyllum rariflorum* J.J.Sm. (159)

clasping the rhachis, 1.8—2.9 mm long, acute to acuminate. *Flowers* imperfectly distichous or scattered, not opening fully, each one developing only after anthesis of the previous. *Pedicel* and *ovary* 5—5.6 mm long, basal node on a c. 0.4—0.7 mm-long stump. *Median sepal* porrect, ovate, 5—6.3 x 2—2.8 mm, index 1.9—2.5; rounded to obtuse, margins ciliate, base rather broadly attached; rather thin, adaxial surface finely papillose distally, otherwise glabrous. *Lateral sepals* recurved, ovate-triangular, 5.3—7.2 x 2.8—4 mm, index 1.4—2.2; obtuse to acute, upper margin slightly papillose, base broadly attached; otherwise as the median sepal. *Petals* porrect, spathulate, 3—3.2 x 1.5—2 mm, index 1.5—2; rounded, margins ciliate distally, base rather broadly attached; thin, adaxial surface finely papillose distally, otherwise glabrous. *Lip* curved near the base, obovate to elliptic, 5.2—6.8 x 2.5—3.3 mm, index 2—2.3; rounded, margins papillose-ciliolate distally; thick; adaxially slightly concave near the base, without a basal callus, with a median slit continuing over about 1/4 of the lip, with two inconspicuous, rounded, proximally diverging ridges in the proximal 1/3 of the lip, with a median strip widening c. half-way up the lip into a vaguely outlined, large, somewhat convex, ovate, glabrous or papillose patch, with the surface otherwise glabrous proximally and often finely papillose or hirsute distally; abaxially with a \pm truncate ridge near the base, surface otherwise slightly concave, glabrous. *Column* 1.5—2 mm long, *Stelidia* triangular, 0.5—0.6 long; acute. *Anther*: front margin erose, abaxially papillose distally.

Colours: Sepals yellowish, distally with purplish veins, proximally with a purplish blotch. Petals yellowish, suffused purplish distally. Lip adaxially yellow or purplish with a dark purple median line, abaxially yellowish.

Habitat & ecology: Lowland kerangas forest.

Distribution: MALAYSIA: Sarawak (2 specimens seen). INDONESIA: Kalimantan (1).

Species fere Cognita

***Bulbophyllum sarcoscapum* Teijsm. & Binn.** (*probably extinct*)

Bulbophyllum sarcoscapum Teijsm. & Binn., Natuurk. Tijdschr. Ned.-Indie 29 (1867) 242. — TYPE: Indonesia, Java, 'in forests of Mt. Madoer, near Bogor', (*collector not indicated*) (not seen).

Rhizome c. 2 mm diam., sections between pseudobulbs c. 3 cm long. *Pseudobulbs* distant, depressed-conical to depressed-globose. *Petiole* 2.2—3 cm. *Leaf blade* elliptic-obovate, 11—23 x 2.3—2.8 cm, index (length/

width) 4.7—9.1; acute to acuminate. *Inflorescence* an elongated, lax raceme, pendulous, 22—26 cm, c. 25-flowered. *Peduncle* c. 16 cm, bracts c. 5, the longest c. 12 mm long. *Rhachis* thickened, c. 0.8 cm diam., glabrous. *Floral bracts* ovate, c. 3 x 2 mm, acute. Pedicel and ovary c. 3 mm. *Flowers* opening wide. *Sepals* reflexed, c. 4 mm long, surface adaxially finely pubescent, abaxially glabrous. *Petals* much shorter, semi-orbicular, margins ciliate. *Lip* ?elliptic, c. 4 mm long, obtuse, margins with hairs; adaxially furrowed, surface glabrous; abaxially with long hairs from base to tip.

Colours: Inflorescence purple. Flowers with blackish purple hairs.

Habitat & ecology: Montane forest.

Distribution: INDONESIA: Java (1 specimen seen). Not collected since c. 1860.

Notes: No type material could be located, in spite of a search in LE and W, where some of the Teysmann collections are stored. A sterile specimen, *Zollinger 947*, from Bandung, Java (W) is likely to be the same species. The description above is compiled from Teijsmann & Binnendijk, and from the W specimen.

Bulbophyllum sarcoscapum is of uncertain taxonomic status; the chances ever to find it again on Java seem remote. The information available suggests a species rather similar to *B. aithorhachis*, but no median ridge on the lip is mentioned in the original description.

Acknowledgements

I owe a debt of gratitude to many people and institutions who have helped me (and still do) in many ways with my self-imposed task of revising as many sections of *Bulbophyllum* as I possibly can. Here, I can mention only a few. The spirit samples made from the extensive living collections in the Botanic Gardens in Leiden, and the by now almost legendary, but unfortunately no longer existing, living collection of *Bulbophyllum* of P. Jongejan, Amersfoort (both in the Netherlands, the material kept in L) must be mentioned. The herbaria AAU, AMES, B, BM, BRI, BO, C, F, K, KEP, KLU, L, LAE, NY, P, PE, S, SZU, SAN, UKMB, W, WU have made material available for study. Jim Cootes (Australia), Bob & Chittima Cowen (Thailand), Bev Debrincat (Australia), Gunter Fischer (Austria), Alexander Kocyan (The Netherlands), Alvin Lok (Singapore), Peter O'Byrne (Singapore), Anton Sieder (Austria), Heok Hui Tan (Singapore) provided material of several rare species. J.F. Veldkamp (The Netherlands) provided the Latin diagnoses.

References

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- Seidenfaden, G. 1979. Orchid genera in Thailand 8: *Bulbophyllum* Thou. *Nordic Journal Botany* **33**, 3: 1—228.
- Vermeulen, J.J. 1993. A taxonomic revision of the genus *Bulbophyllum*, sections *Adelopetalum*, *Lepanthanthe*, *Macrouris*, *Pelma*, *Peltopus* and *Uncifera*. *Orchid Monographs* **7**: 1—324.

Identification lists

This identification list includes all collections examined for this revision.

Identification list sorted according to the species:

111 - *Bulbophyllum penduliscapum* - Beccari, O. PB 3113; PB 3144; Hort. Bogor HLB 905.234-4797; HLB 924.325-179; Hort. Bogor, comm. nr. 008; 064; 091; 134; 420; Hort. Leiden 026209; Jacobson, E.R. s.n.; Jongejan, P. cult. 2990; Lamb, A. 1989/1105; SAN (Amin & Sign) 069164; (Lamb, A.) 092332; Tenom Orchid Centre (T.O.C.) cult. 1787; Vermeulen, J.J. 1158; 1302; Vermeulen, J.J., & Duistermaat, H. 1147; Wenzel, C.A. 761; 865.

112 - *Bulbophyllum gymnopus* - Clarke, C.B. 42549; F.K.W. 7705; Herb. Hooker f. s.n.; Griffith 5133; 5134; Hort. Kew EN 596-68; King's collectors s.n.; Pantling, R. 357; Parry, N.E. 484; Seidenfaden, G. & Smitinand, T. (GT) 8643; 8869; Tessier-Yandell 02.

113a - *Bulbophyllum farinulentum* subsp. *farinulentum* - Beaman, J.H. (et al.) 07006; Carr, C.E. 0106; FRI (Ng, F.S.P.) 27102; Hort. Leiden 020771; 026544; 914306; Hort. Singapore SBG-O 0594; Kerr, A.F.G. 113; Lamb, A. s.n. (Supat, A.) 1989/1101; SAN (Fidilis Krispinus) 118814.

113b - *Bulbophyllum farinulentum* subsp. *densissimum* - Hort. Leiden 914076; SAR (Ashton, P.S.) 16531; Syngé, P.M. 98.

114 - *Bulbophyllum fulvibulum* - Hort. Leiden 930900; 970299; Jongejan, P. cult. 1814; Vermeulen, J.J. 0603.

115 - *Bulbophyllum nemorale* - BSC (Fenix, E.) 28356; Kalkman, C., & Tissing, M.O. 4187; PNH (Edano, G.E.) 12707; Wenzel, C.A. 871; 922; 928.

116 - *Bulbophyllum disjunctum* - Argent, G. & Coppins, B. 1167; Bakhtiar Effendi bin Yahya 56; Beaman, J.H. (et al.) 06764; (et al.) 07238; (et al.) 11128; Carr, C.E. 3212; Clemens, J., & Clemens, M.S. 00254; 27361; 32554; 32787; 40226; Collenette, S. 1002; Comber, J. 103; FRI (Saw, L.G.) 71675; Lamb, A. 1983 158; 1990 1246; Mahadimenakbar 64; Nor Hashimah Abu Hani 44; SAN (Aban Gibot) 056304; (Lamb, A.) 087497; SAR (Native coll.) 05049; (Asah Ak Luang) 22741; (Chai, P.) 33968; (Martin, P.J.) 38167; (Ilias Paie) 40717; (Awa, D., & Yii, P.C.) 46827; (Yii, P.C., & Abu Talib) 58237; (Yii, P.C., & Abu Talib) 58476; Sato, T. 0793; (et al.) 1849; SFN (Moulton, J.C.) 06664; UKM (Mohd. Kasim) 23704; Vermeulen, J.J., & Duistermaat, H. 0697; Vogel, E.F. de 8212.

117 - *Bulbophyllum placoichilum* - Clemens, J., & Clemens, M.S. 33922; 34056; SFN (Carr, C.E.) 27938.

118 - *Bulbophyllum elongatum* - Blume, C.L. 195; 287; s.n.; HLB 902.322-934; BSC (Loher, A.) 14730; Carr, C.E. (1929 03) s.n.; Curtis, G. s.n.; Elmer, A.D.E. 09823; Grieve, H.G. 32; Hort. Leiden 026216; Mohd. Shah 2788; Reeve, T.M. 1098; 6025; Ridley, H.N. (1893) s.n.; (1893) s.n.; (1908 11) s.n.; Royen, P. van. Sleumer, H., & Schram, F. 7795; Sands, M.J.S. 5285; SAR (Lai, S.T., Rantai, &

Awg Enjah) 75308; SFN (Holtum, R.E.) 21582; Wenzel, C.A. 351; 704.

119 - *Bulbophyllum lissoglossum* - Carr, C.E. 3371; Clemens, J., & Clemens, M.S. 29820; Griswold J.A. 79; SAN (Lamb, A., "KL. 3021") 087149; (Lamb, A., "LKC 3190") 091580; SFN (Carr, C.E.) 27249; Vermeulen, J.J., & Chan, C.L. 0390; Vermeulen, J.J., & Duistermaat, H. 1086.

120 - *Bulbophyllum gemma-reginae* - Jongejan, P. cult. 1856.

121 - *Bulbophyllum carinilabium* - Beaman, J.H. 08952; Hort. Leiden 026443; Sato, T. 0265; SFN (Carr, C.E.) 26987; Vermeulen, J.J. 0641a.

122 - *Bulbophyllum hirtulum* - Ahmad (1894) s.n.; Ajoeb (Exp. Jacobson, E.R.) 807; Carr, C.E. 0194; (1933/03) s.n.; Chan, C.L. s.n.; Collenette, S. 0719; Hort. Bogor HLB 920.342-4; Hort. Leiden 913046; 914195; 970483; Hort. Singapore (Carr, C.E., & Holtum, R.E.) s.n.; (Ridley) (1909) s.n.; (Tan, H.H.) SBG-O 0316; SBG-O 2166; Korthals, P.W. s.n.; Lewis, G.P. 291; Ridley, H.N. & Curtis, G. (1899 03) s.n.; Tenom Orchid Centre (T.O.C.) cult. 1203; Vermeulen, J.J. 0636.

123 - *Bulbophyllum cerebellum* - Carr, C.E. 3470; Giles 998; Kocyan, A. (1999/10/22) s.n.

124 - *Bulbophyllum clipeibulbum* - Hort. Salzburg OR 637/94; Hort. Singapore SBG-O 2087.

125 - *Bulbophyllum penicillium* - Hort. Glasnevin s.n.; (1917/05/24) s.n.; O'Brien, J. cult. (1895/06) s.n.; Pantling, R. 251; Parish, C. 303; Prain's collector 89.

126 - *Bulbophyllum setuliferum* - FRI (Saw, L.G.) 44299; Hort. Singapore SBG-O 0490; SBG-O 0499; SBG-O 0625; Lok, F.A. cult. 053.

127 - *Bulbophyllum sororculum* - Brans, M. s.n.

128 - *Bulbophyllum aithorhachis* - Jongejan, P. cult. 2219; Schrage, A.H. (1954/03/01) s.n.

129 - *Bulbophyllum echinophilum* - Hort. Muenchen (Loher) (1916/12) s.n.

130 - *Bulbophyllum lanuginosum* - Thaitong 1395.

131 - *Bulbophyllum atratum* - Chang, C.K. cult. s.n.; Hort. Bogor s.n.; HLB 921.250-380; Hort. Singapore SBG-O 0087; Jacobson, E.R. s.n.

132 - *Bulbophyllum groeneveldtii* - Hort. Leiden 026335; Jacobson, E.R. cult. (Groeneveldt) 951; Jongejan, P. cult. 1818; Vermeulen, J.J., & Duistermaat, H. 0971; 1107.

133 - *Bulbophyllum grotianum* - Hort. Leiden 970530.

134 - *Bulbophyllum janus* - Micholitz, W. s.n.; Robinson, H.C., & Boden Kloss, C. (1914/03/15) s.n.

135 - *Bulbophyllum xiphion* - Hort. Leiden 913241; Vogel, E.F. de. & Cribb, P.J. 9062.

136 - *Bulbophyllum mirabile* - Hort. Bogor HLB 908.100-122; HLB 924.325-695; Hort. Bogor, comm. nr. 006; 036; 153; Hort. Glasnevin s.n.; Hort. Leiden 949339; Jongejan, P. cult. 4031.

138 - *Bulbophyllum polycyclum* - Hort. Leiden 913457; Jongejan, P. cult. 1870.

- 139 - *Bulbophyllum lindleyanum*** - Day, J. 63; F.F. 48; Foerstermann, I.F. 08; Herb. Reichenbach, H.G. (Foerstermann) 15563; Hort. Singapore SBG-O 2185; SBG-O 2186; Lok, F.A. cult. 057; Seidenfaden, G. & Smitinand, T. (GT) 6139; SFN (Haniff & Nur) 02702; (Haniff & Nur) 10301.
- 140 - *Bulbophyllum tremulum*** - Beddome, R.H. 8179; Herb. Reichenbach, H.G. (Wight) 49425; Hort. Kew (1925/04/27) s.n.; Hort. Leiden 022802; Jongejan, P. cult. 4544; Lawrence, T. cult. (1901/02/28) s.n.; Meebold, A. 8533.
- 141 - *Bulbophyllum scaphiforme*** - Hort. Vienna 1992 182; Seidenfaden, G. & Smitinand, T. (GT) 2099; 7464; 8332; 8332a; Tixier, P. s.n.
- 142 - *Bulbophyllum nigripetalum*** - Henry, A. 13055; Hort. Glasnevin (1892 05) s.n.; Hort. Kew (1915/01) s.n.; (1916/03 13) s.n.; (1919/05 22) s.n.; Lawrence, T. cult. (1899/04) s.n.; Maxwell, J.F. 1989 524; Morrison, A. 1032; O'Brien, J. cult. (1888) s.n.; (1889/04) s.n.; (1891/05/18) s.n.; Seidenfaden, G. & Smitinand, T. (GT) 7656.
- 143 - *Bulbophyllum nigrescens*** - Cumberlege 1021; Hort. Aarhus 1978 B-232; Hort. Vienna 099B 104; 1995 446; Jongejan, P. cult. 2591; Kerr, A.F.G. 084; (1915/03/14) s.n.; Lawrence, T. cult. (1898 02) s.n.; Maxwell, J.F. 1989 523; Menzies, D., & Dupuy, D. 328; Seidenfaden, G. & Smitinand, T. (GT) 8332b; Smitinand, T. 10168.
- 144 - *Bulbophyllum trulliferum*** - Tenom Orchid Centre (T.O.C.) cult. 2321.
- 145 - *Bulbophyllum jolandae*** - Vermeulen, J.J. 0602.
- 146 - *Bulbophyllum comberipictum*** - Hort. Leiden 914194.
- 147 - *Bulbophyllum lasioglossum*** - Borden, T.E. 797; Elmer, A.D.E. 17687; Topping, D. LeRoy (1904/05) s.n.
- 148 - *Bulbophyllum negrosianum*** - Elmer, A.D.E. 09821; Hort. Vienna 1990 176.
- 149 - *Bulbophyllum dracunculus*** - Carr, C.E. 3647; Clemens, J., & Clemens, M.S. 32908; Collenette, S. 0535; Hort. Leiden 030978.
- 150 - *Bulbophyllum polygaliflorum*** - Carr, C.E. 3595; Hansen, C. 499; SFN (Carr, C.E.) 27956.
- 151 - *Bulbophyllum ochthodes*** - Hort. Singapore SBG-O 0616.
- 152 - *Bulbophyllum phreatiopse*** - Hoogland, R.D. & Craven, L.A. 10899; Reeve, T.M. 5772.
- 153 - *Bulbophyllum parviflorum*** - Cooper, R.E. 1239; Hort. Glasnevin (1914 10) s.n.; (1915/10/13) s.n.; Hort. Leiden 960104; Jongejan, P. cult. 1974; King, G. s.n.; Pantling, R. 245; Parish, C. 305; Seidenfaden, G. & Smitinand, T. (GT) 8524; 8549; Thomson (1850) s.n.
- 154 - *Bulbophyllum secundum*** - Beusekom, C.F. van, & Phlengkhlai, C. 1271; Evrard, F. 1018; Garrett, H.B.G. 795; Grey-Wilson & Phillips 93; Hort. Glasnevin (1904/07) s.n.; Jongejan, P. cult. 0303; 0889; Kerr, A.F.G. 180; Maxwell, J.F. 1988 685; Pantling, R. 214; Prain, D. 41; Samuel, A. 13549; Sander cult. (1895 06) s.n.; Swinhoe, R. 122; Tsi, Z.H. 1991/ 544; White, K. 406.
- 155 - *Bulbophyllum deprincatiae*** - Debrincat, B. cult. (leg. Cootes, J.E.) 001.

156 - *Bulbophyllum pilosum* - Vermeulen, J.J. 0562.

157 - *Bulbophyllum xenosum* - Jongejan, P. cult. 4425.

158 - *Bulbophyllum limbatum* - Burkill, H.M. 1789; Carr, C.E. (1920/08) s.n.; Hort. Bogor HLB 914,150-360; HLB 921,250-248; Hort. Leiden 960104; 970478; Hort. Singapore (1932/08) s.n.; Jeppesen, H.L. (1920/08) s.n.; Jongejan, P. cult. 3995; 4256; Lamb, A. 1988/ 925; Loddiges, C. s.n.; Mohd. Shah & Kadim 383; SAN (Dewol Dundaling) 134960; SFN (Moulton, J.C.) 06757; (Moulton, J.C.) 06758; Tenom Orchid Centre (T.O.C.) cult. (Lamb, A.) (1989/01) s.n.; Teruya, Z. 1890.

159 - *Bulbophyllum rariflorum* - Hort. Bogor (1909) s.n.; HLB 913,114-114; II, M.C. 133; Hort. Bogor , comm. nr. 116; 128; 130; 136; Jongejan, P. cult. 2013; 2214.

* - ***Bulbophyllum sarcoscapum*** - Zollinger, H. 947.

Identification list sorted according to the specimens:

The identifications are given as numbers between square brackets. These numbers correspond with the species numbers in this revision. To facilitate the use of the identification lists, an enumeration of the taxa with their numbers is given.

- | | |
|---|---|
| [111] <i>B. penduliscapum</i> J.J. Sm. | [135] <i>B. xiphion</i> J.J. Verm. |
| [112] <i>B. gymnopus</i> Hook.f. | [136] <i>B. mirabile</i> Hallier. |
| [113] <i>B. farinulentum</i> J.J. Sm. | [137] <i>B. spadiciflorum</i> Tixier. |
| [113a] ssp. <i>farinulentum</i> | [138] <i>B. polycyclum</i> J.J. Verm. |
| [113b] ssp. <i>densissimum</i> (Carr) J.J. Verm. | [139] <i>B. lindleyanum</i> Griff. |
| [114] <i>B. fulvibulbum</i> J.J. Verm. | [140] <i>B. tremulum</i> Wight |
| [115] <i>B. nemorale</i> L.O Williams | [141] <i>B. scaphiforme</i> J.J. Verm. |
| [116] <i>B. disjunctum</i> Ames & C. Schweinf. | [142] <i>B. nigripetalum</i> Rolfe |
| [117] <i>B. placochilum</i> J.J. Verm. | [143] <i>B. nigrescens</i> Rolfe |
| [118] <i>B. elongatum</i> (Blume) Hassk. | [144] <i>B. trulliferum</i> J.J. Verm. |
| [119] <i>B. lissoglossum</i> J.J. Verm. | [145] <i>B. jolandae</i> J.J. Verm. |
| [120] <i>B. gemma-reginae</i> J.J. Verm. | [146] <i>B. comberipictum</i> J.J. Verm. |
| [121] <i>B. carinilabium</i> J.J. Verm. | [147] <i>B. lasioglossum</i> Rolfe ex Ames |
| [122] <i>B. hirtulum</i> Ridl. | [148] <i>B. negrosianum</i> Ames |
| [123] <i>B. cerebellum</i> J.J. Verm. | [149] <i>B. dracunculus</i> J.J. Verm. |
| [124] <i>B. clipeibulbum</i> J.J. Verm. | [150] <i>B. polygaliflorum</i> J.J. Wood |
| [125] <i>B. penicillium</i> Par. & Rchb.f. in Rchb.f. | [151] <i>B. ochthodes</i> J.J. Verm. |
| [126] <i>B. setuliferum</i> J.J. Verm. & L.G. Saw | [152] <i>B. phreatiopse</i> J.J. Verm. |
| [127] <i>B. sororculum</i> J.J. Verm. | [153] <i>B. parviflorum</i> Par. & Rchb.f. in Rchb.f. |
| [128] <i>B. aithorhachis</i> J.J. Verm. | [154] <i>B. secundum</i> Hook.f. |
| [129] <i>B. echinophilum</i> Kraenzl. | [155] <i>B. deprincatae</i> J.J. Verm. |
| [130] <i>B. lanuginosum</i> J.J. Verm. | [156] <i>B. pilosum</i> J.J. Verm. |
| [131] <i>B. atratum</i> J.J. Sm. | [157] <i>B. xenosum</i> J.J. Verm. |
| [132] <i>B. groeneveldtii</i> J.J. Sm. | [158] <i>B. limbatum</i> Lindl. |
| [133] <i>B. grotianum</i> J.J. Verm. | [159] <i>B. rariflorum</i> J.J. Sm. |
| [134] <i>B. janus</i> J.J. Verm. | [*] <i>B. sarcoscapum</i> Teysm. & Binn. |

Ahmad (1894) s.n. [122]; **Ajoeb (Exp. Jacobson, E.R.)** 807 [122]; **Argent, G. & Coppins, B.** 1167 [116].

Bakhtiar Effendi bin Yahya 56 [116]; **Bans, M.** s.n. [127]; **Beaman, J.H.** (et al.) 06764 [116]; (et al.) 07006 [113a]; (et al.) 07238 [116]; 08952 [121]; (et al.) 11128 [116]; **Beccari, O.** PB 3113 [111]; PB 3144 [111]; **Beddome, R.H.** 8179 [140]; **Beusekom, C.F. van, & Phlengkhlai, C.** 1271 [154]; **Blume, C.L.** 195 [118]; 287 [118]; s.n. [118]; HLB 902,322-934 [118]; **Borden, T.E.** 797 [147]; **BSC** (Loher, A.) 14730 [118]; (Fenix, E.) 28356 [115]; **Burkill, H.M.** 1789 [158].

Carr, C.E. 0106 [113a]; 0194 [122]; 3212 [116]; 3371 [119]; 3470 [123]; 3595 [150]; 3647 [149]; (1920/08) s.n. [158]; (1929/03) s.n. [118]; (1933/03) s.n. [122]; **Chan, C.L.** s.n. [122]; **Chang, C.K. cult.** s.n. [131]; **Clarke, C.B.** 42549 [112]; **Clemens, J., & Clemens, M.S.** 00254 [116]; 27361 [116]; 29820 [119]; 32554 [116]; 32787 [116]; 32908 [149]; 33922 [117]; 34056 [117]; 40226 [116]; **Collenette, S.** 0535 [149]; 0719 [122]; 1002 [116]; **Comber, J.** 103 [116]; **Cooper, R.E.** 1239 [153]; **Cumberlege** 1021 [143]; **Curtis, G.** s.n. [118].

- Day, J.** 63 [139]; **Debrincat, B. cult. (leg. Cootes, J.E.)** 001 [155].
- Elmer, A.D.E.** 09821 [148]; 09823 [118]; 17687 [147]; **Evrard, F.** 1018 [154].
- F.F.** 48 [139]; **F.K.W.** 7705 [112]; **Foerstermann, I.F.** 08 [139]; **FRI** (Ng, F.S.P.) 27102 [113a]; (Saw, L.G.) 44299 [126]; (Saw, L.G.) 71675 [116].
- Garrett, H.B.G.** 795 [154]; **Giles** 998 [123]; **Grey-Wilson & Phillips** 93 [154]; **Grieve, H.G.** 32 [118]; **Griffith** 5133 [112]; 5134 [112]; **Griswold J.A.** 79 [119].
- Hansen, C.** 499 [150]; **Henry, A.** 13055 [142]; **Herb. Hooker f.** s.n. [112]; **Herb. Reichenbach, H.G.** (Foerstermann) 15563 [139]; (Wight) 49425 [140]; **Hoogland, R.D. & Craven, L.A.** 10899 [152]; **Hort. Aarhus** 1978/ B-232 [143]; **Hort. Bogor** s.n. [131]; (1909) s.n. [159]; HLB 905,234-4797 [111]; HLB 908,100-122 [136]; HLB 913,114-114 [159]; HLB 914,150-360 [158]; HLB 920,342-4 [122]; HLB 921,250-248 [158]; HLB 921,250-380 [131]; HLB 924,325-179 [111]; HLB 924,325-695 [136]; II, M.C. 133 [159]; **Hort. Bogor, comm. nr.** 006 [136]; 008 [111]; 036 [136]; 064 [111]; 091 [111]; 116 [159]; 128 [159]; 130 [159]; 134 [111]; 136 [159]; 153 [136]; 420 [111]; **Hort. Glasnevin** s.n. [125]; s.n. [136]; (1892/05) s.n. [142]; (1904/07) s.n. [154]; (1914/10) s.n. [153]; (1915/10/13) s.n. [153]; (1917/05/24) s.n. [125]; **Hort. Kew** (1915/01) s.n. [142]; (1916/03/13) s.n. [142]; (1919/05/22) s.n. [142]; (1925/04/27) s.n. [140]; EN 596-68 [112]; **Hort. Leiden** 020771 [113a]; 022802 [140]; 026209 [111]; 026216 [118]; 026335 [132]; 026443 [121]; 026544 [113a]; 030978 [149]; 913046 [122]; 913241 [135]; 913457 [138]; 914076 [113b]; 914194 [146]; 914195 [122]; 914306 [113a]; 930900 [114]; 949339 [136]; 960104 [158]; 960104 [153]; 970299 [114]; 970478 [158]; 970483 [122]; 970530 [133]; **Hort. Muenchen** (Loher) (1916/12) s.n. [129]; **Hort. Salzburg** OR 637/94 [124]; **Hort. Singapore** (Carr, C.E., & Holtum, R.E.) s.n. [122]; (Ridley) (1909) s.n. [122]; (1932/08) s.n. [158]; SBG-O 0087 [131]; (Tan, H.H.) SBG-O 0316 [122]; SBG-O 0490 [126]; SBG-O 0499 [126]; SBG-O 0594 [113a]; SBG-O 0616 [151]; SBG-O 0625 [126]; SBG-O 2087 [124]; SBG-O 2166 [122]; SBG-O 2185 [139]; SBG-O 2186 [139]; **Hort. Vienna** 099B 104 [143]; 1990/ 176 [148]; 1992/ 182 [141]; 1995/ 446 [143].
- Jacobson, E.R.** s.n. [131]; s.n. [111]; **Jacobson, E.R. cult.** (Groeneveldt) 951 [132]; **Jeppesen, H.L.** (1920/08) s.n. [158]; **Jongejan, P. cult.** 0303 [154]; 0889 [154]; 1814 [114]; 1818 [132]; 1856 [120]; 1870 [138]; 1974 [153]; 2013 [159]; 2214 [159]; 2219 [128]; 2591 [143]; 2990 [111]; 3995 [158]; 4031 [136]; 4256 [158]; 4425 [157]; 4544 [140].
- Kalkman, C., & Tissing, M.O.** 4187 [115]; **Kerr, A.F.G.** 084 [143]; 113 [113a]; 180 [154]; (1915/03/14) s.n. [143]; **King's collectors** s.n. [112]; **King, G.** s.n. [153]; **Kocyan, A.** (1999/10/22) s.n. [123]; **Korthals, P.W.** s.n. [122].
- Lamb, A.** s.n. [113a]; 1983/ 158 [116]; 1988/ 925 [158]; (Supat, A.) 1989/ 1101 [113a]; 1989/ 1105 [111]; 1990/ 1246 [116]; **Lawrence, T. cult.** (1898/02) s.n. [143]; (1899/04) s.n. [142]; (1901/02/28) s.n. [140]; **Lewis, G.P.** 291 [122]; **Loddiges, C.** s.n. [158]; **Lok, F.A. cult.** 053 [126]; 057 [139].
- Mahadimenakbar** 64 [116]; **Maxwell, J.F.** 1988/ 685 [154]; 1989/ 523 [143]; 1989/ 524 [142]; **Meebold, A.** 8533 [140]; **Menzies, D., & Dupuy, D.** 328 [143]; **Micholitz, W.** s.n. [134]; **Mohd. Shah** 2788 [118]; **Mohd. Shah & Kadim** 383 [158]; **Morrison, A.** 1032 [142].

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O'Brien, J. cult. (1888) s.n. [142]; (1889/04) s.n. [142]; (1891/05/18) s.n. [142]; (1895/06) s.n. [125].

Pantling, R. 214 [154]; 245 [153]; 251 [125]; 357 [112]; **Parish, C.** 303 [125]; 305 [153]; **Parry, N.E.** 484 [112]; **PNH** (Edano, G.E.) 12707 [115]; **Prain's collector** 89 [125]; **Prain, D.** 41 [154].

Reeve, T.M. 1098 [118]; 5772 [152]; 6025 [118]; **Ridley, H.N.** (1893) s.n. [118]; (1893) s.n. [118]; (1908/11) s.n. [118]; **Ridley, H.N. & Curtis, G.** (1899/03) s.n. [122]; **Robinson, H.C., & Boden Kloss, C.** (1914/03/15) s.n. [134]; **Royen, P. van, Sleumer, H., & Schram, F.** 7795 [118].

Samuel, A. 13549 [154]; **SAN** (Aban Gibot) 056304 [116]; (Amin & Sigin) 069164 [111]; (Lamb. A., "KL. 3021") 087149 [119]; (Lamb. A.) 087497 [116]; (Lamb. A., "LKC 3190") 091580 [119]; (Lamb. A.) 092332 [111]; (Fidilis Krispinus) 118814 [113a]; (Dewol Dundaling) 134960 [158]; **Sander cult.** (1895/06) s.n. [154]; **Sands, M.J.S.** 5285 [118]; **SAR** (Native coll.) 05049 [116]; (Ashton, P.S.) 16531 [113b]; (Asah Ak Luang) 22741 [116]; (Chai, P.) 33968 [116]; (Martin, P.J.) 38167 [116]; (Ilias Paie) 40717 [116]; (Awa, D., & Yii, P.C.) 46827 [116]; (Yii, P.C., & Abu Talib) 58237 [116]; (Yii, P.C., & Abu Talib) 58476 [116]; (Lai, S.T., Rantai, & Awg Enjah) 75308 [118]; **Sato, T.** 0265 [121]; 0793 [116]; (et al.) 1849 [116]; **Schrage, A.H.** (1954/03/01) s.n. [128]; **Seidenfaden, G. & Smitinand, T. (GT)** 2099 [141]; 6139 [139]; 7464 [141]; 7656 [142]; 8332 [141]; 8332a [141]; 8332b [143]; 8524 [153]; 8549 [153]; 8643 [112]; 8869 [112]; **SFN** (Haniff & Nur) 02702 [139]; (Moulton, J.C.) 06664 [116]; (Moulton, J.C.) 06757 [158]; (Moulton, J.C.) 06758 [158]; (Haniff & Nur) 10301 [139]; (Holttum, R.E.) 21582 [118]; (Carr, C.E.) 26987 [121]; (Carr, C.E.) 27249 [119]; (Carr, C.E.) 27938 [117]; (Carr, C.E.) 27956 [150]; **Smitinand, T.** 10168 [143]; **Swinhoe, R.** 122 [154]; **Synge, P.M.** 98 [113b].

Tenom Orchid Centre (T.O.C.) cult. 1203 [122]; 1787 [111]; 2321 [144]; (Lamb. A.) (1989/01) s.n. [158]; **Teruya, Z.** 1890 [158]; **Tessier-Yandell** 02 [112]; **Thaitong** 1395 [130]; **Thomson** (1850) s.n. [153]; **Tixier, P.** s.n. [141]; **Topping, D. LeRoy** (1904/05) s.n. [147]; **Tsi, Z.H.** 1991/ 544 [154].

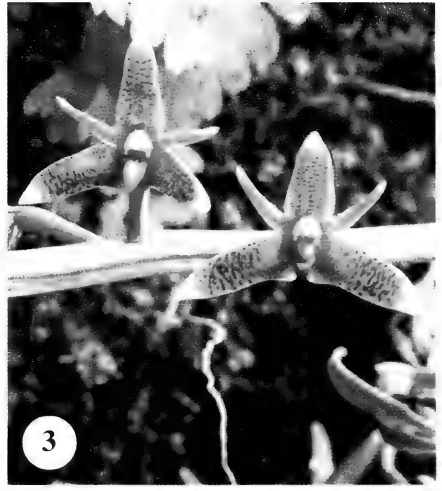
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Vermeulen, J.J. 0562 [156]; 0602 [145]; 0603 [114]; 0636 [122]; 0641a [121]; 1158 [111]; 1302 [111]; **Vermeulen, J.J., & Chan, C.L.** 0390 [119]; **Vermeulen, J.J., & Duistermaat, H.** 0697 [116]; 0971 [132]; 1086 [119]; 1107 [132]; 1147 [111]; **Vogel, E.F. de** 8212 [116]; **Vogel, E.F. de, & Cribb, P.J.** 9062 [135].

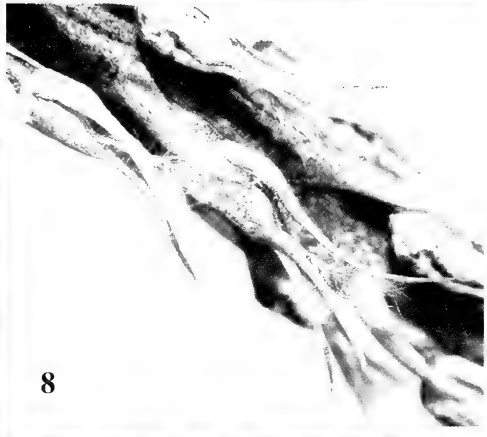
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Zollinger, H. 947 [*].

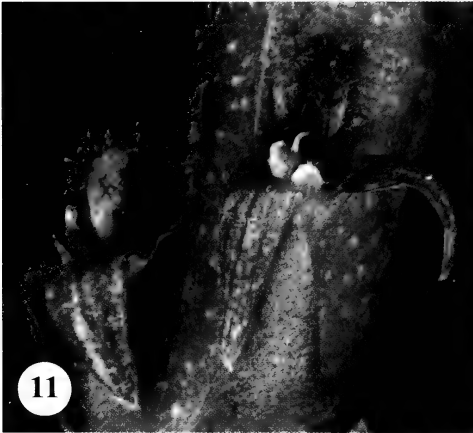
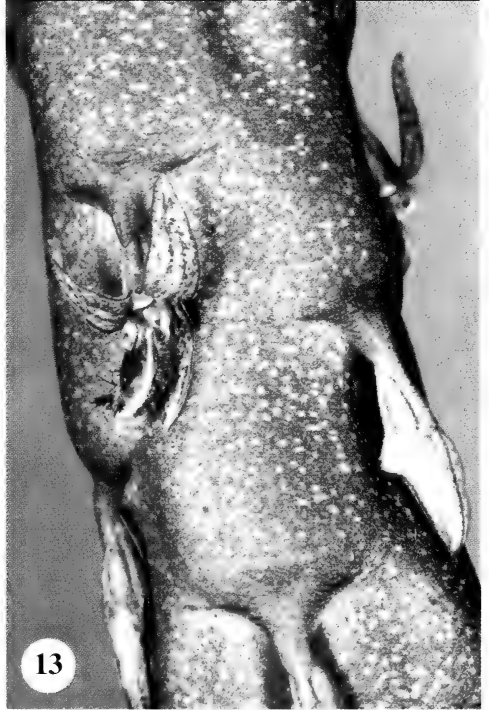
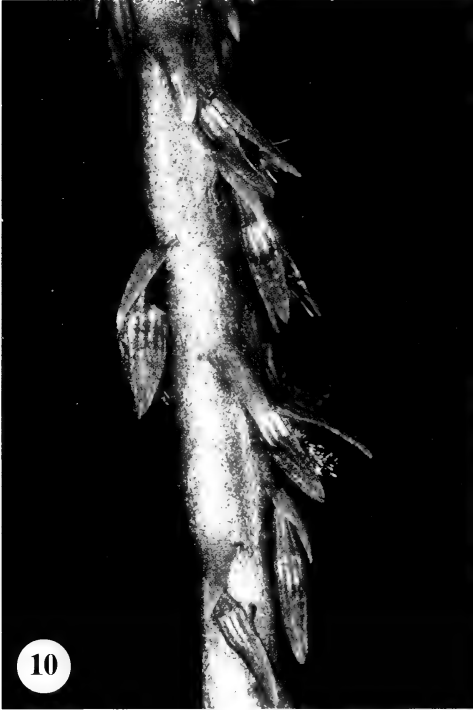
- 1 *Bulbophyllum penduliscapum* J.J. Sm. (111). – *Jongejan cult.* 2990 (P. Jongejan).
- 2 *Bulbophyllum farinulentum* J.J. Sm. ssp. *densissimum* (Carr) J.J. Verm. (113b). — *Hort. Leiden* 914076 (A. Schuiteman).
- 3 *Bulbophyllum fulvibulbum* J.J. Verm. (114). — *Hort. Leiden* 930285 (A. Meivogel).
- 4 *Bulbophyllum disjunctum* Ames & C. Schweinf. (116). – *Hort. Leiden* 980182 (A. Schuiteman).



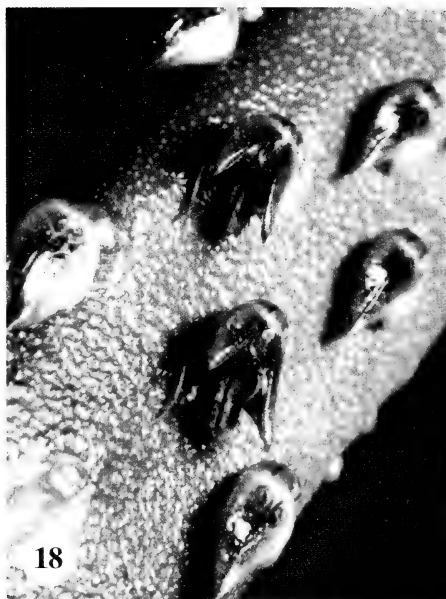
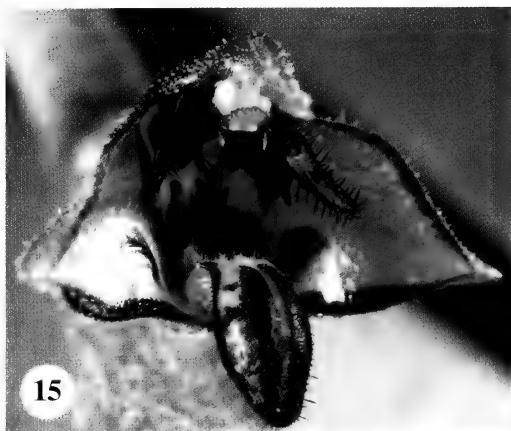
- 5 *Bulbophyllum gemma-reginae* J.J. Verm. (120). — *Jongejan cult.* 1856 (P. Jongejan).
- 6 *Bulbophyllum carinilabium* J.J. Verm. (121). — *Hort. Leiden* 26443 (A. Schuiteman).
- 7 *Bulbophyllum cerebellum* J.J. Verm. (123). — *Kocyan s.n.* (A. Kocyan).
- 8 *Bulbophyllum clipeibulbum* J.J. Verm. (124). — *Hort. Vienna* O99B160-2 (G. Fischer).
- 9 *Bulbophyllum penicillium* Par. & Rchb.f. in Rchb.f. (125). — (P. Jongejan).



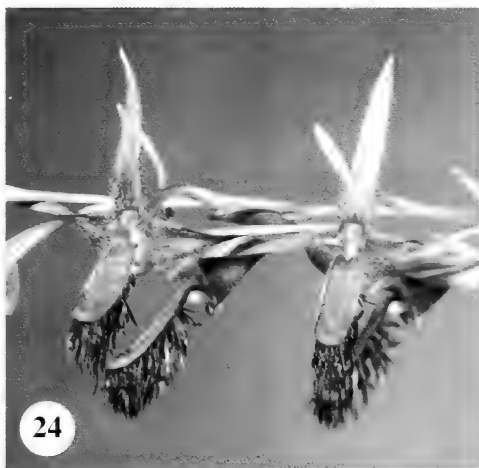
- 10 *Bulbophyllum setuliferum* J.J. Verm. & L.G. Saw (126). — *Hort. Singapore SBG-O 499* (P. O'Byrne).
- 11 *Bulbophyllum sororculum* J.J. Verm. (127). — *M. Brans s.n.* (M. Brans).
- 12 *Bulbophyllum aithorhachis* J.J. Verm. (128). — *Jongejan cult. 2219* (P. Jongejan).
- 13 *Bulbophyllum aithorhachis* J.J. Verm. (128). — *Jongejan cult. 2219* (P. Jongejan).
- 14 *Bulbophyllum atratum* J.J. Sm. (131). — *Hort. Singapore SBG-O 087* (P. O'Byrne).



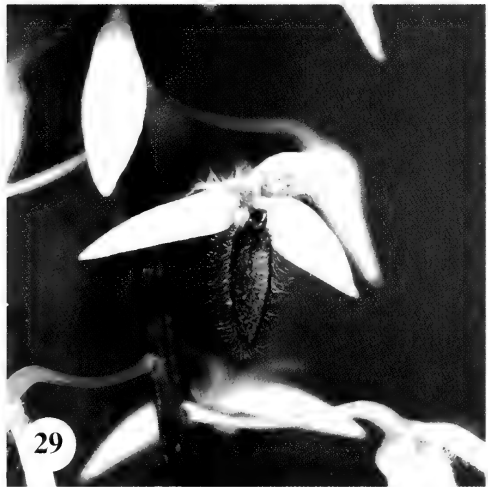
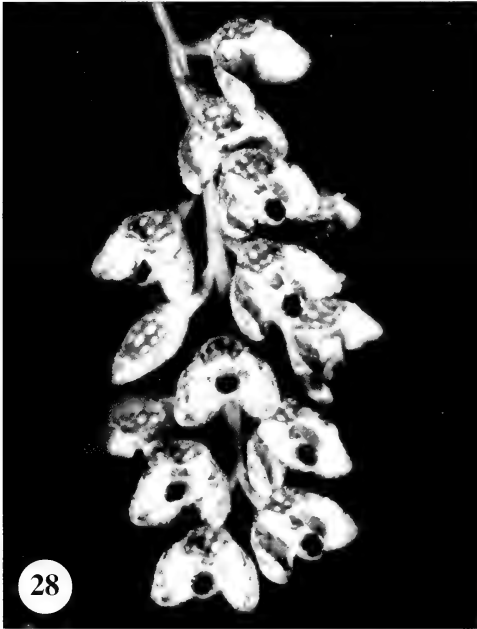
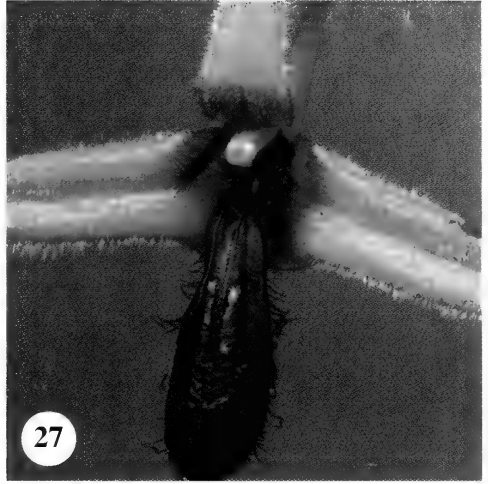
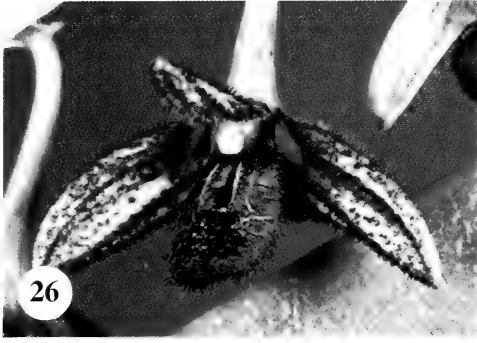
- 15 *Bulbophyllum groeneveldtii* J.J. Sm. (132). — *Jongejan cult. 1818* (P. Jongejan).
- 16 *Bulbophyllum grotianum* J.J. Verm. (133). — *Hort. Leiden 970603* (A. Schuiteman).
- 17 *Bulbophyllum grotianum* J.J. Verm. (133). — *Hort. Leiden 970603* (A. Schuiteman).
- 18 *Bulbophyllum xiphion* J.J. Verm. (135). — *Hort. Leiden 913241* (P. Jongejan).
- 19 *Bulbophyllum xiphion* J.J. Verm. (135). — *Cribb 9062* (P. Cribb).



- 20 *Bulbophyllum mirabile* Hallier, flowers near the base of the inflorescence (136). – *Jongejan cult. 4031* (P. Jongejan).
- 21 *Bulbophyllum mirabile* Hallier, flowers near the top of the inflorescence (136). – *Jongejan cult. 4031* (P. Jongejan).
- 22 *Bulbophyllum polycyclum* J.J. Verm. (138). – *Jongejan cult. 1870* (P. Jongejan).
- 23 *Bulbophyllum lindleyanum* Griff. (139). – *Hort. Vienna s.n.* (A. Sieder).
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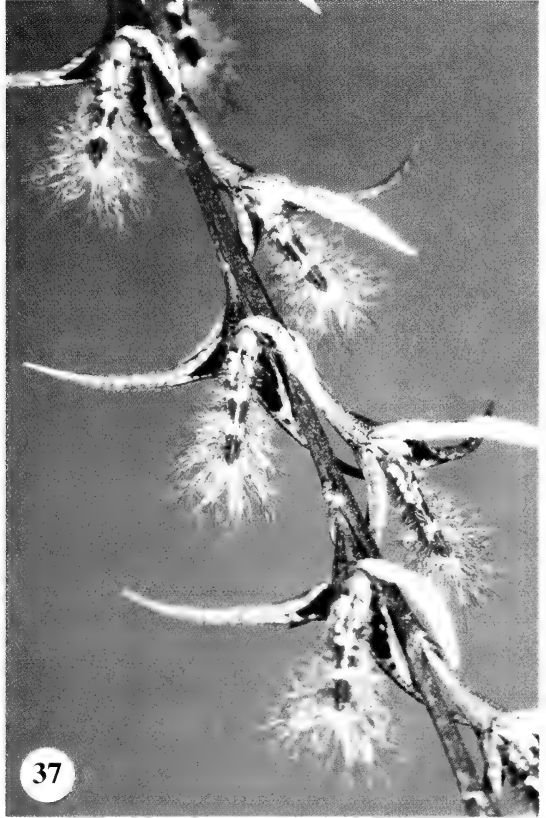
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- 36 *Bulbophyllum debrincatae* J.J. Verm. (155). – *Debrincat cult.* (leg. Cootes) 001 (D. Titmuss).
- 37 *Bulbophyllum xenosum* J.J. Verm. (157). — *Jongejan cult.* 4425 (P. Jongejan).
- 38 *Bulbophyllum limbatum* Lindl. (158). – *Jongejan cult.* (P. Jongejan).



***Bulbophyllum praetervisum* J.J. Verm. (Orchidaceae), an Overlooked Species Close to *B. macranthum* Lindl.**

J.J. VERMEULEN

Singapore Botanic Gardens
Singapore 259569

Abstract

Bulbophyllum praetervisum sp. nov. is described, a species very similar in general aspect to *Bulbophyllum macranthum* Lindl., but differing in the shape of the column and the lip

While revising *Bulbophyllum* sect. *Sestochilus*, I found that specimens of two different species were included under *B. macranthum* Lindl. in Vermeulen (1991: 263). Vegetatively and in the general aspect of the flowers the two are remarkably similar. However, they clearly differ in the shape of the column and the lip. One is doubtless *B. macranthum* Lindl., but the other is new. It is formally described below; full information will be given in the forthcoming revision of the section.

***Bulbophyllum praetervisum* J.J. Verm., sp. nov.**

Bulbophyllum praetervisum J.J. Verm., a *B. macrantho* ob dentem triangularem secus stolidiorum marginem inferiorem et labelli apicem valde recurvatum differt. –
TYPE: Malaysia, Sabah, Bukit Hampuan, *Tenom Orchid Centre (T.O.C.) cult. 934* (K, holo.)

Other material seen: BRUNEI. No exact locality, *Van Niel 3845* (L).

Notes: The holotype specimen is depicted in Vermeulen (1991: 262). *Bulbophyllum praetervisum* differs from *B. macranthum* Lindl. in having a triangular, acute tooth along the lower margin of each stolidium. The lip is also different, particularly in lateral view: in *B. praetervisum* it is almost straight proximally, with only the tip recurved in a hook-like manner; in *B. macranthum* it is gradually curved over most of its length.

While *B. macranthum* is almost restricted to lowland conditions, *B. praetervisum* also tolerates higher altitudes: in Sabah it has been found at 1500 m alt.

References

- Vermeulen, J.J. 1991. *Orchids of Borneo 2: Bulbophyllum*. Royal Botanic Gardens, Kew, and Toihaan Publishing Company Sdn. Bhd., Kota Kinabalu, Sabah, Malaysia.

Book Review: Ian M. Turner. 2001. **The Ecology of Trees in the Tropical Rain Forest.** 298 pages. Cambridge University Press, Cambridge, United Kingdom. ISBN 0-521-80183-4. Price: S\$75.90

This book by Ian Turner represents an outstanding introduction to the biology of tropical rainforest trees, and represents an ideal background text for researchers and students wanting to dig more deeply into the subject. It would be ideal for research students in plant ecology prior to conducting more field work, it would be essential background for students in animal ecology to understand the system in which animals are living, and it would represent the logical next book for those people who enjoyed reading the more general books by T.C. Whitmore (*An Introduction to Tropical Rain Forests*) and P.W. Richards (*The Tropical Rain Forest*). This new book has its focus on the individual tree, rather than the forest itself as in these previous two books. As such, the book presents material, which connects with these books, but does not duplicate their focus. The book would also make an excellent discussion book for a graduate level course on tropical trees.

The book is organized according to the life cycle of the tree, beginning with the growing tree, with good coverage of the trunk, the roots and leaves. The next chapter covers tree performance, considering growth and mortality. Reproductive biology comes next, considering breeding systems, pollination and fruit dispersal. Logically following is a chapter on seed size, and seedling form and ecology. The final chapter considers the characteristics and usefulness of systems of tree classifications, including pioneer versus climax trees, level of shade tolerance, and size and canopy position at the time of flowering.

Within each of these chapters, the material is organized by more specific topics. The overall effect is very satisfying. Individual topics are introduced, the major issues are presented, controversies are presented, the most relevant research is referenced and summarized, and then areas requiring further research are outlined. In effect, much of the presentation is organized as mini-reviews of the most important topics in tropical tree ecology. How does sap ascend tropical trees in a high humidity environment? Why do trees have buttresses? Do mineral nutrients, light or other factors limit tree growth? Why are the leaves of so many tropical trees similar in shape? Do trees have clumped or scattered distributions, and are patterns caused by density-dependant effects? Can seedlings and adult trees be classified into shade-tolerant and shade-intolerant species, or are they better classified as pioneer and climax species?

The book will be useful to researchers with both general and specific

interests. For example, I have wondered whether tropical legume trees in the forest fix nitrogen. I have periodically asked people about this, but I have not gotten a specific or authoritative answer. This specific topic is dealt with here with a clear and efficient one-and-a-half page summary of the latest ideas and literature. Information is presented that 23% of caesalpinoid legumes, which are trees in the forest, have been recorded to form root nodules with nitrogen-fixing bacteria; much less than the 97% of papilionoid legumes which form nodules. It may be that low phosphorus availability, soil acidity, and abundant aluminium inhibit nitrogen fixation in these systems. However, work with stable isotopes does indicate nitrogen fixation in many tropical tree legumes, casuarina trees and cycads. The section also includes a brief mention of the presumed evolutionary origins of this relationship. I mention this example in detail because it was one that I was particularly interested in, and here found such a concise and informative discussion.

I think that for many students and researchers the extended discussion of the evidence for shade intolerance and shade tolerance, pioneer and climax species, and tree size would well be worth the price of the book. There is abundant research on this topic, but Turner summarizes the key evidence and points out the correlations among these various ways of looking at trees, and the preponderance of continuity of species along axes of characteristics rather than species fitting into neat categories.

There is one way in which I think the book fails to live up to its promise. On the final page, in his final section, *Where does this leave us?* Turner states, "One of my objectives when I set out to write this book was to see if there was a new synthesis of the comparative ecology of tropical trees awaiting discovery amidst the voluminous literature on tropical rain forests. I have failed to find a new synthesis." I think Turner is wrong here on two counts. First, he has provided numerous syntheses of significant controversies in tropical ecology, which will guide research projects for years to come. People will read this book and obtain ideas about what are likely to be productive areas of research.

But more importantly, I think that Turner has failed to outline the ways in which tropical trees will respond to the ever-increasing threats to forests posed by human activity. These problems represent the next major round of research in this field, but Turner does not discuss them. For example, what will be the impact on tree biology of global climate change? If the climate becomes warmer or drier, or the atmosphere has a higher carbon dioxide concentration, how will this affect individual trees and the forest in general? Will this tip the scale to trees with a certain type of physiology or growth form or shade intolerance? If forests are increasingly

fragmented by human activities, including logging, agriculture, roads, ranching, and fire, how will this affect trees? And lastly, how will tropical trees respond to human-caused changes in their reproduction? Introduced Africanized honeybees are taking over pollination systems throughout Latin America, seed dispersing animals are being hunted out of the forest throughout the tropics to the point that many trees are no longer having their seeds dispersed, and cattle and fire in the forest understorey are eliminating the forest understorey in many places. These topics considered together represent the new direction of research in the ecology of tropical trees. Even though Turner did not outline this next major area of research, his book represents a tremendous advance in the field and is to be greatly appreciated.

Richard B. Primack

Biology Department

Boston University

5 Cummington Street

Boston, MA 02215, U.S.A.



Book Review: J.B. Comber 2001. **Orchids of Sumatra.** x + 1026 pages. The Royal Botanic Gardens, Kew, U.K. ISBN 1 84246 027 7. Price: GBP 95.00, RM 450.00.

Until the publication of this book, the orchid flora of Sumatra had been badly neglected, particularly when you consider all the recent publications on the orchids of Java, Borneo, Peninsular Malaysia and Thailand. The main source of information has long been a checklist compiled by J.J. Smith and published in 1933. Any attempt to identify a Sumatran orchid usually started with a rather discouraging check in J.J. Smith's list, it continued with a lengthy search through a lot of old journals and the literature on the orchid flora of surrounding areas, and it all too often proved indecisive. It could be species X, but it could equally well be species Y. This changed when Jim Comber decided to combine the information present in the old literature with his excellent knowledge of west Malesian orchids and the new information (mainly photographs) that he had gathered during the years he lived on Sumatra. The first orchid flora of Sumatra is now a fact.

The book is written following the lines of a normal flora: there is a short introduction to the island of Sumatra, its people, its history and its vegetation. This is followed by a key to the orchid genera, and keys to all the orchid species. Each genus and species is shortly described; similarities and taxonomic problems are shortly discussed below each taxon. For a relatively small number of species, analytical drawings have been included, most of these copied from originals by Rudolf Schlechter. And then, of course, there are the numerous large colour photographs of magnificent quality, most of which show close-ups of the flowers. While many of the photographs show the plant growing *in situ*, a large number show plants that were growing elsewhere in SE Asia, so they may not represent the precise form found in Sumatra. We understand that much of the delay in publishing this long-awaited volume was due to Comber's insistence that the photographs appear throughout the book alongside the relevant text, rather than the much cheaper option of grouping them together and inserting them as a series of colour plates. This treatment has resulted in a book that has attained a much higher standard of presentation than most floras; not only is the book informative, but it is a pleasure to use.

Of course, this volume also has a number of shortcomings, most obviously those that result from the fact that there are still so many gaps in our knowledge of the orchid flora of Sumatra. For example, many species are known from the type material only, often collected long ago and in several cases unfortunately now lost. For Comber, it must have been

frustrating to deal with such species, and problematic attempting to give them their proper place in the enumeration. Another frustration must have been Comber's inability to collect fresh material; this has resulted in several undescribed species being illustrated by photographs, but lacking a formal name, description or herbarium specimen. It is a real shame that these species could not have been described properly. There are also some shortcomings of a more technical nature; it would have been useful if more analytical sketches had been included. J.J. Smith's drawings are available to only relatively few people. They could have been copied just like Schlechter's drawings, and they would have facilitated identification.

As will be clear from the above, and as stated by Comber himself, this book is a preliminary study. Much work remains to be done, and large areas still need to be explored properly. Comber adds modestly '... but at least it is a start'. It is definitely more than that. It is an excellent work of reference for everybody interested in the orchid flora of West Malesia.

Jaap J. Vermeulen and Peter O'Byrne
Singapore.

Book Review: R. Govaerts, D.G. Frodin and T.D. Pennington 2002. **World Checklist and Bibliography of Sapotaceae.** xi + 361 pages. The Royal Botanic Gardens, Kew, U.K. ISBN 1 900347 94 6. Softback. Price: GBP 57.50.

The fifth in the series, this volume covers the Sapotaceae, an important tropical family particularly in the Malesian region. This volume includes 54 genera and 1,250 species as well as 3,689 synonyms below generic rank. The layout, as with previous volumes, is clear and well organized making it quick and easy to retrieve information. Unlike other checklists, the bibliography gives a brief summary of the important conclusions for the major references and the species lists aim to be taxonomically validated based mainly on an assessment of the literature but where necessary consulting specialists and the herbarium. Where there is doubt about identity, this is indicated.

The volume is essential reference for botanists working away from major libraries and will save a great deal of time for individual taxonomists to draw up species lists from scattered literature. In this connection, providing the distribution of species is particularly useful.

I 'tested' its usefulness in comparing the names of the Bornean Sapotaceae in the latest volume of *Tree Flora of Sabah and Sarawak* (April, 2002). The Kew Sapotaceae had captured all names but had 'misspelt' *Madhuca sarawahensis* (as 'sarawakensis'). On the other hand, they were correct in the spelling of *Palaquium cochleariifolium*, which was misspelt in the Tree Flora. The notable omission was the five new species and four other name changes made by Yii and Chai (2001). This is a serious limitation of printed work in that it can very soon be out of date.

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- Yii, P.C. and P.P.K. Chai. 2001. New combinations, new names and new species of *Madhuca* (Sapotaceae) from Sabah and Sarawak, Borneo. *Gardens' Bulletin Singapore*. **53**: 343—356.
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Ruth Kiew

Singapore Botanic Gardens
Singapore

Book Review: J.F. Maxwell and S. Elliott 2001. **Vegetation and Vascular Flora of Doi Sutep-Pui National Park, Northern Thailand.** Biodiversity Research and Training Program, Bangkok, Thailand. x + 205 pages, 36 colour photographs. ISBN 947 7360 61 6. Price: US\$ 10.

The Doi Sutep-Pui National Park west of Cheng Mai city was established in 1981, its higher peak reaches 1,685 m. It is the site of the famous 600-year old Doi Sutep Temple.

This is a landmark publication and sets a high standard as a model for biodiversity inventories of National Parks. In SE Asia and Malesia, there is almost a complete dearth of accurate and complete information for the plant species and associations found in National Parks. Part III by Maxwell provides a detailed annotated enumeration of vascular plants (2,247 species in 195 families) in the Doi Sutep-Pui National Park based on extensive fieldwork over a period of 13 years. The strength of this section is in the care taken over accuracy of identification based on an extensive collection of herbarium specimens.

Plant associations in the Park are described in Part II by Maxwell and Elliott based on data from transects. The account details the vegetation structure, species composition for all life forms and their abundance, and the correlation between altitude, soil type and disturbance for the six associations found in the Park. Their work clearly shows that the primary evergreen seasonal forest without pine is the most biodiverse association, both in number of species and in having more than double the number of rare and endangered species, and that the summit vegetation has almost completely been destroyed. Interwoven into the account is an interesting discussion of the relative abundance of deciduous and evergreen associations and the effect of disturbance, particularly of fire, on them. This section also includes a historical account of plant collecting in the Park area from the first collections made by C. Hosseus in 1904 as well as listing species originally described from the Park (confusingly referred to in the text as 'new species' although many were described about a hundred years ago!).

Of particular value is Elliott's description in Part IV of management in the Park to maintain its integrity and biodiversity when 6,460 Hmong villagers live within the Park and another 51,109 on the boundary. Already 43 per cent of the Park's land has been converted to agriculture. Elliott's active involvement with the Forest Restoration Research Unit is a practical example of how local communities can be involved in tree planting for reforestation and for fire prevention; how in planting 40 indigenous tree species (of the 600 tree species found in the Park) research is needed on their basic biology in the selection and generation of seed and the

establishment of seedlings; and how the Park serves as a living laboratory for education and research; and as a vital seed source of wild and endangered trees.

Maxwell in Part I takes the opportunity to provide a detailed historical review of the various systems in the literature for classifying the Thai flora into vegetation types. Based on his own field work, he then makes a plea for vegetation types to be based on a holistic approach that takes into account a broader range of species (not just a few economically important timber trees or a few dominant tree species) as well as vegetation structure, that distinguishes phases of plant succession (especially to appreciate the effect of fire on vegetation), and that places more emphasis on altitude as well as seasonality. He stresses that all forest types in Thailand are seasonal vegetation types and that describing the seasonal forest in southern Thailand as 'tropical rain forest' is an incorrect application of the term. Whether his conclusions will indeed be widely accepted or are widely applicable in Thailand can now be tested against the clear framework that he has provided, besides setting standards for the detailed ecological work required to make this assessment.

The conclusion from reading the book is that the Doi Sutep-Pui National Park is a flagship for biodiversity in Thailand with 20 per cent of the Thai flora in just 261 km². It also points to the urgent necessity of conservation management as already 55 species recorded from the Park were not recollected by Maxwell and Elliot and presumably no longer occur there, while another 53 are critically endangered. Scientifically, it is especially important as the type site of 512 species, more than any other National Park or locality in Thailand. The problems the National Park faces from fire, lack of watershed management, encroachment by agriculture, and 'development' for tourism are common to many National Parks in SE Asia and Elliott's positive approach therefore has wide applications elsewhere. On the other hand, Maxwell's antagonist reference to eco-pornography is counter-productive.

The book ends with a comprehensive list of references and an index to species. It contains very few typographical errors, though page 7 records average rainfall as 1000—2000 m! For the wealth of information, the book is inexpensive and should not only be in the libraries of all botanical institutions in the region but also in the resource centres of National Parks and environmental NGOs.

Ruth Kiew

Singapore Botanic Gardens
Singapore

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Literature citations: Citations in the text should take the form: King and Chan (1964). If several papers by the same author in the same year are cited, they should be lettered in sequence (1964a), (1964b), etc. When papers are by three or more authors they should be cited as e.g., Geesink *et al.* (1981). All references must be placed in alphabetic order according to the surname of the (first) author and the journal title be given in full, as in the following example:

Stone, B.C. 1994. Additional notes on the genus *Glycosmis* Correa (Rutaceae). *Gardens' Bulletin Singapore*. 46: 113-119.

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Ridley, H.N. 1930. *The Dispersal of Plants Throughout the World*. L.Reeve, Ashford, Kent.

For literature citations in taxonomic papers the following style is required:

Medinilla alternifolia Blume, Mus. Bot. Lugd.-Bat. I:2 (1849) 19.
Sterculia acuminatissima Merr., Philip. J. Sci. 21 (1922) 524.

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***Coprosma bougainvilleensis* (Rubiaceae), A New Species from Bougainville Island, Papua New Guinea**

O.G. GIDEON

Division of Biological Sciences, School of Natural and Physical Sciences,
The University of Papua New Guinea, PO Box 320, University PO,
National Capital District 134, Papua New Guinea

Abstract

With the description of a new species, *C. bougainvilleensis* Gideon, from Bougainville, the genus *Coprosma* (Rubiaceae) is reported for the first time from the Solomons. The species is described and illustrated. Infrageneric relationships and biogeography are briefly discussed.

Introduction

In May 1988, I had the opportunity to collect on Bougainville and Buka islands. One of the most interesting collecting sites was Mt Balbi, a dormant volcano, whose summit at 2,590 m is the highest point on the island of Bougainville. Amongst the many plants collected from this mountain was a curious species of *Coprosma*. The discovery of *Coprosma* on Bougainville was exciting because, firstly, *Coprosma* was not previously known from the Solomons Group or the Bismarck Archipelago, and secondly, it showed no resemblance to any of the *Coprosma* species from New Guinea, plants that I am familiar with. Examining the collection at LAE, I was able to establish that it represents a distinct new species, and that it shows affinities with a Pacific group of *Coprosma*. This species is in striking contrast to the New Guinea species, which are generally low spreading shrubs with small, obscurely veined leaves.

Coprosma bougainvilleensis* Gideon *sp. nov.

A *Coprosma novaehebridae* in foliis omnino glabris, stipulis edentatis eciliatis, inflorescentis terminalis et baccis comparate maioribus (9–10.5 mm longis contra 5 mm longos) differt. **Typus:** Papua New Guinea - Bougainville Island: Mt Balbi, Emperor Range, *Gideon LAE 78543*, 8 May 1988 (LAE, holo; L, UPNG, iso).

Figure 1

Erect dioecious shrub, 2–5 m tall, young branchlets tetragonous, glabrous. *Leaves* opposite, narrowly elliptic, with 6–8 prominent veins on each side of the midrib, blade entirely glabrous, 8–13 by 2–3.5 cm, base cuneate, apex acuminate, acumen 6–15 mm; petiole glabrous, terete, 1–2 cm long. *Stipules* triangular, connate with the bases of the petioles, 5–7 mm long, caudate, acumen 3–4 mm long, base 5–6 mm broad, entirely glabrous. *Inflorescence* terminal, in few- to several-flowered cymes, either on the main axes or on lateral branches of a higher order. *Flowers* small, pale greenish. *Male flowers*: calyx green, glabrous, 4- or 5-lobed, lobes deltoid or triangular, 0.5–1 mm long; corolla funnel-shaped to campanulate, tube 3–5 mm long, lobes 4 or 5, narrowly ovate, 4–6 by 1.5–4 mm, apex acute; stamens 4 (or 5), inserted at the base of the corolla tube, filaments filiform, 15–20 mm long, anthers dorsifixed, greatly exerted and dangling, 5v6 mm long, base sagittate, apex acute, opening with two introrse slits. *Female flowers*: calyx similar to that of male flowers; corolla tubular, 6–7.5 mm long, entirely glabrous, lobes 4 or 5, narrowly ovate, 3–4 by 0.5–1.5 mm, apex acute, staminodes absent. Ovary ovoid-globose, 2-locular, ovules solitary, 1–2.5 by 1–2 mm, glabrous; style with 2 long stigmatic lobes, stylar part 3–3.5 mm long, stigma lobes greatly exerted, 26–30 mm long, hispidulous. *Fruit* a globose drupe, 9–10.5 by 9–10 mm, green, ripening bright red and crowned by the persistent calyx; pyrenes 2, stony, ellipsoid, 6–7 by 3–4 mm.

Distribution: So far known only from the type locality.

Habitat: A very common plant in moderately open situations in the forest, along walking tracks and along creek banks. Growing on volcanic ash soils between 1900 and 2300 m altitude.

Notes: The affinity of this new species appears to lie with the western Polynesian group “*Persicaeifoliae*” (subgenus *Lucidae* C.J. Webb), which includes three species, each endemic to a single island, Samoa, Fiji or Vanuatu. The group is characterised by lanceolate leaves with pilose veins, triangular, ciliate, dentate stipules, and shortly branched peduncles. Among these, it most nearly resembles the Vanuatu species, *Coprosma novaehebridae* W.R.B. Oliv., which has a sparsely pilose lamina and pilose petiole; ciliate, dentate stipules; and a 5-mm long fruit. (Oliver was unable to describe the flowers as none was available). In contrast, *C. bougainvilleensis* is entirely glabrous, the stipules are neither ciliate nor dentate, and the fruits are 9–10.5 mm long.

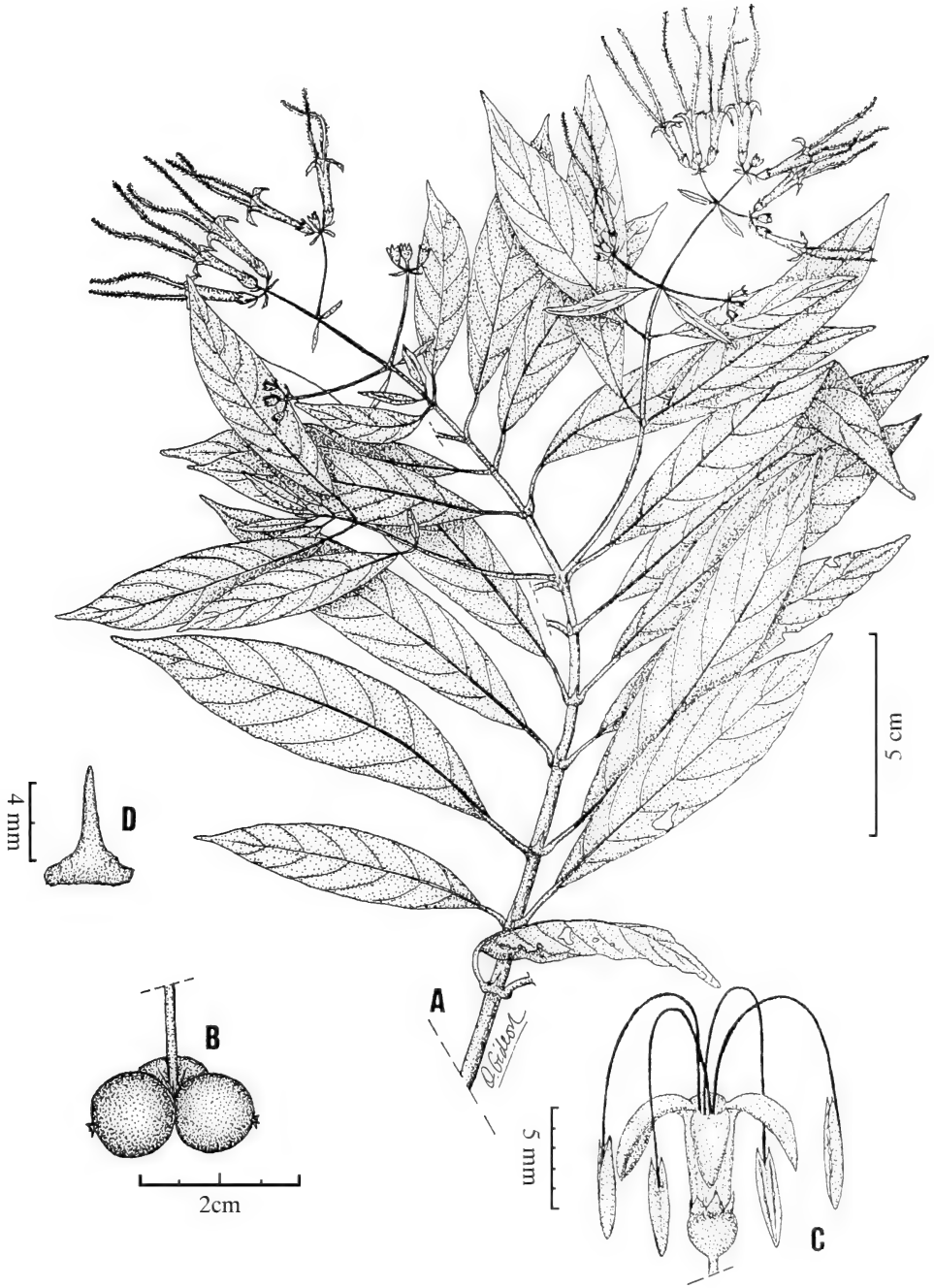


Figure 1. *Coprosma bougainvilleensis* Gideon

A - female flowering twig; B - Fruits; C - Male flower; D - stipule.

Although *C. bougainvilleensis* most resembles *Coprosma* in tribe *Anthospermeae*, it is anomalous in having terminal cymes; all the rest of the genus have axillary inflorescences and inflorescence position is generally quite stable in tribe *Anthospermeae*. Its generic position is therefore regarded as provisional until the Australasian members of the *Anthospermeae* are better understood. Molecular data may prove useful in shedding light on its affinities.

Other specimens examined: Mt Balbi, Emperor Range, Bougainville Island, Papua New Guinea. *Gideon LAE 78596* (LAE); *Gideon LAE 78597* (LAE). (Duplicates of these collections will shortly be distributed from LAE).

Taxonomic and Biogeographic Notes

Coprosma J.R. & G. Forst. is a large, mainly southern temperate genus of about 90 species (Darwin, 1979), recently expanded to include *Nertera* Banks & Sol. ex Gaertn. and *Leptostigma* Arn., bringing the total to 128 species (Heads, 1996). The genus is centred in New Zealand, and has a secondary centre of diversity in the Hawaiian Islands. *Coprosma* is placed within the south temperate amphi-pacific subtribe *Coprosminae* Puff in tribe *Anthospermeae* Cham. & Schltldl. The *Anthospermeae* are characterised by their unisexual, anemophilous flowers, undoubtedly a derived condition in the predominantly zoophilous Rubiaceae. The stigmatic lobes are usually long and filiform, and are completely covered with hispidulous hairs, significantly increasing their receptive surfaces. They are usually longer than the style.

In his treatment of the New Zealand *Coprosma*, Hooker f. (1864) recognised two main groups, based on whether the female flowers are clustered or solitary, a distinction generally accepted by later workers at subgeneric level (Oliver, 1935; Allan, 1961; Heads, 1996). Oliver, the only monographer of the genus, recognised seven informal groups. Heads (1996) reduced the genera *Nertera* and *Leptostigma* to sections of *Coprosma*, and somewhat modified the subgeneric concepts to accommodate the changes.

Coprosma bougainvilleensis differs from all New Guinea species of *Coprosma* by its generally larger stature and larger leaves (8–13 by 2–3.5 cm) with 6–8 prominent lateral veins. The mainland New Guinea species are usually low spreading shrubs with small (3–35 by 1–10 mm), obscurely veined, needle-tipped leaves, and all occur in the alpine regions. Heads (1996) placed most of the New Guinea species in the informal group “Malesia” within the subgenus *Coprosma*.

Heads (1996) provided an in-depth discussion of the evolution and

biogeography of *Coprosma*, and interested readers are referred to that paper. Prior to the inclusion of *Nertera* and *Leptostigma* in *Coprosma*, the two clearly distinct groups (subgenera) were western (subgenus *Coprosma*) or eastern (subgenus *Lucidae*) in distributional range, with both groups overlapping in New Zealand and Hawaii (see Heads, 1996, Fig.1), both important centres of species diversity for the genus. The evolution and biogeography of the *Coprosminae* remains controversial. Puff (1986) suggested that the present distribution and diversity of the *Coprosminae* in the southern regions was a result of long distance dispersal from the north followed by secondary speciation, while Heads (1996) argued that the present distribution of *Coprosma* is a result of vicariance rather than dispersal. We must look to molecular biology to provide a more precise estimation of the geographic origin and the evolutionary relationships of the *Coprosminae*. The intrusion of the subgenus *Lucidae* into Papuasias is probably best explained by (short distance) dispersal, and birds are the most likely candidates as dispersers.

Acknowledgements

I wish to thank Dr J.F. Veldkamp for commenting on an earlier draft of this paper and also for translating the Latin diagnosis, and to an anonymous reviewer for useful comments. R. Kiapranis (LAE) and Dr M. Heads of the University of Goroka (Papua New Guinea) are thanked for their help and encouragement, especially the latter for persuading me to publish the new species, as are Simeon Obedi and Yakas Lelean, former staff of LAE, who accompanied me on the plant collecting expedition.

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Two Remarkable New West Malesian *Homalomena* (Araceae) Species

A. HAY AND C. HERSCOVITCH

Royal Botanic Gardens Sydney,
Mrs Macquaries Road,
Sydney 2000, Australia

Abstract

Two very distinctive new species of *Homalomena* Schott (Araceae-Homalomeneae) are described from Sumatera (*H. elegantula* A. Hay & Herscovitch) and Borneo (*H. expedita* A. Hay & Herscovitch). Both are illustrated.

Introduction

Homalomena Schott is a genus of about 100 species of terrestrial or lithophytic forest-dwelling herbs. Most are Malesian, with a few in continental SE Asia and the neotropics. The genus is most closely allied to and possibly congeneric with *Furtadoa* M. Hotta (West Malesia), the two genera forming the tribe Homalomeneae. *Furtadoa* is distinguished by its monandrous male 'flowers' with the stamens aligned in a regularly transverse pattern (in relation to the spadix axis) and with a pistillode associated with each (versus at least diandrous male flowers without pistillodes in *Homalomena*). However, Sumateran *H. monandra* M. Hotta is intermediate in having monandrous male 'flowers' in the same configuration as those of *Furtadoa* but without associated pistillodes. The tribe is currently considered most closely allied to neotropical Philodendreae (Mayo *et al.*, 1997).

Homalomena has been recently revised for New Guinea (Hay, 1999) and Java (Yuzammi, 2000). Progress with revising the genus for the rest of the *Flora Malesiana* region has unfortunately slowed, however, and therefore we are publishing the more distinctive taxa as they come to light.

1. *Homalomena elegantula* A. Hay & Herscovitch, *sp. nov.*

A *Homalomena bellula* Schott habitu repenti, foliis distantibus, petiolo ad apicem geniculato, lamina anguste elliptica longe cuspidata, inflorescentia valde minore differt. **Typus:** Indonesia, Sumatera, West Sumatera, East of Pajakumbuh, Taram, sandstone region of River Tjampo, 24 Aug 1957, W. Meijer 6928 (L, holo).

Figure 1

Slender creeping herb to c. 25 cm tall. *Rhizome* very slender, elongate, creeping, c. 5 mm diam. *Leaves* few, distant, about 5 cm apart on the rhizome, subtended and enclosed by cataphylls in bud; petiole 15–22 cm long, erect, apically sharply bent holding the blade at right angles, geniculate at the junction with blade, sheathing only at the extreme base; blade narrowly elliptic, slightly falcate, 17–20 cm long, c. 3 cm wide, the base acute, the tip cuspidate-acuminate for c. 4 cm and apiculate for c. 2 mm, drying greyish adaxially, reddish brown abaxially; midrib slender and very prominent abaxially, impressed adaxially, with 6–8 primary lateral veins on each side; primary lateral veins very weakly differentiated from the secondary venation, diverging at c. 30–45° and somewhat prominent abaxially and adaxially. *Inflorescences* several together, subtended by sublinear cataphylls to c. 3 cm long; peduncle slender, to 4 cm long, declinate after anthesis. *Spathe* unconstricted, spindle-shaped, c. 1 cm long, c. 2.5 mm thick (before anthesis), c. 1.2 cm long, c. 5 mm thick (after anthesis). *Spadix* very shortly stipitate for c. 0.5 mm; female zone 2 mm long, c. 1.5 mm diam.; pistils crowded; ovary subglobose-ovoid, drying rust-brown, c. 0.3 mm diam.; stigma button-like, somewhat narrower than the ovary, raised on a short style; infra-pistillar staminodes somewhat shorter than the ovary, clavate on a very short stipe, c. 0.2 mm diam., ivory; male zone contiguous with the female, cylindric, distally tapering to a point, drying ivory yellow; male flowers 2-staminate; stamens truncate, c. 0.5 mm across; thecae opening through large subapical pores; connective slightly elevated beside and between the pores. *Fruiting spathe* broadly spindle-shaped.

Distribution: Malesia: endemic to Sumatra (West Sumatra; known only from the type).

Habitat: Terrestrial in hill forest over sandstone, 500–1000 m alt.

Notes: *Homalomena elegantula*, though its minute inflorescence closely resembles those of *H. humilis* (Jack) Hook.f and allies, is distinguished from that group by its remarkable habit. Shoot organisation appears comparable to that of *H. hastata* M.Hotta and *H. bellula* Schott, with flowering being both functionally and anatomically terminal and renewal taking place by the release of a dormant lateral bud. The architecture of the rhizome thus resembles that of many gingers and most *Schismatoglottis* species allied to *S. calyptrata* (Roxb.) Zoll. & Moritz (Hay & Yuzammi, 2000). This organisation is in marked contrast to that of other *Homalomena* species where the shoot consists of a physiognomically unbranched

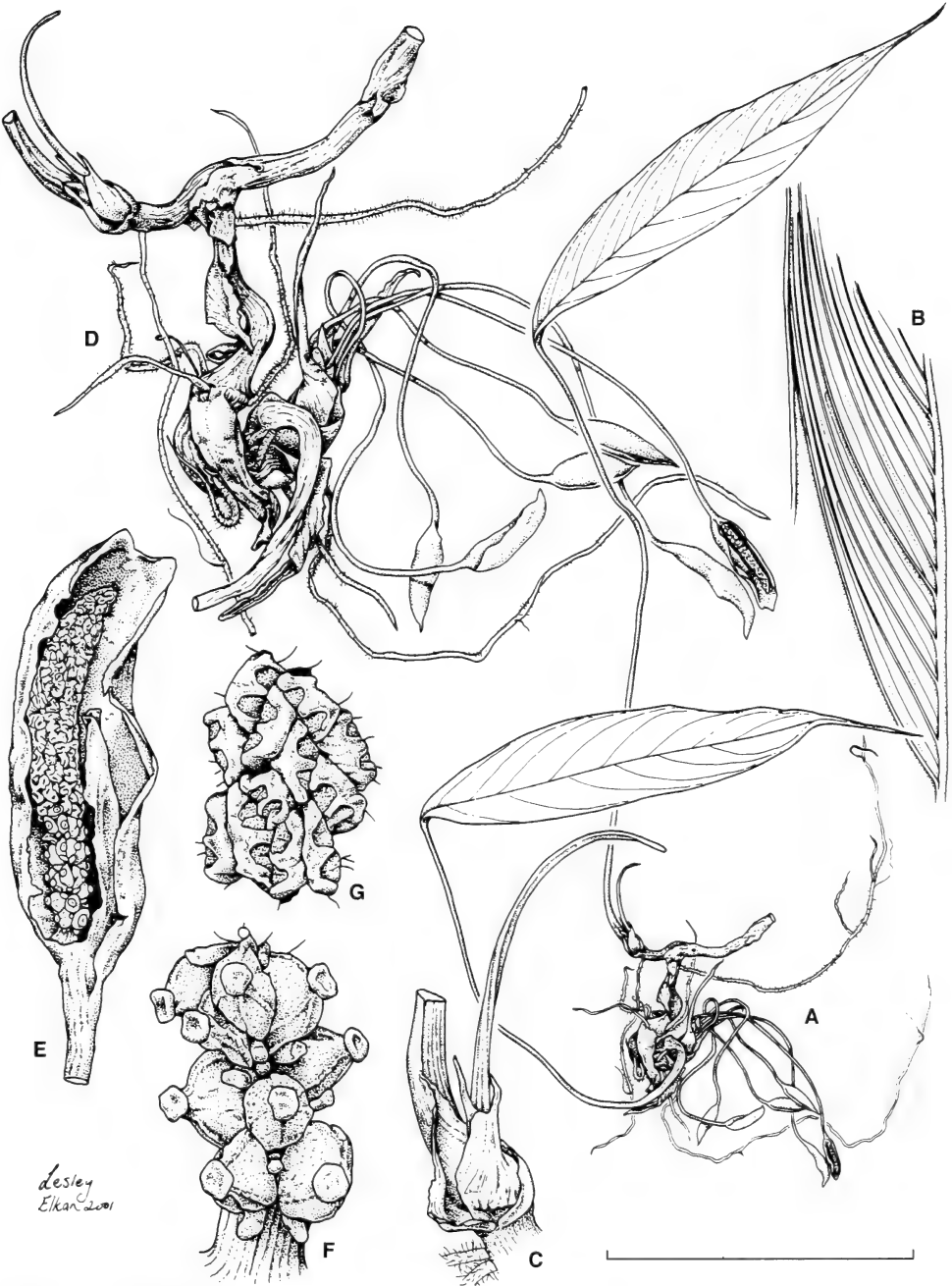


Figure 1. *Homalomena elegantula* A. Hay & Herscovitch

W. Meijer 6928 – A. habit; B. leaf venation; C. detail of vegetative tip of rhizome showing leaf base and cataphylls; D. rhizome with synflorescence; E. inflorescence with part of spathe removed; F. pistils and staminodes; G. stamens.

Scale: bar to A = 12 cm, to B = 2.7 cm, to C = 3 cm, to D = 6 cm, to E = 7 mm, to F & G = 1.5 mm.

sympodium typical of most herbaceous Araceae. It has not previously been recorded in this genus. The leaves of *H. elegantula* are preceded and enclosed by a series of cataphylls and evidently the bud containing the next foliage leaf is extended some distance from the previous one giving the plant its long creeping habit. However, the exact architectural organisation is impossible to observe from the single dried specimen known to us. The elegant leaves (to which the epithet refers) are remarkable for appearing to be held, through the action of a geniculum, such that the blades all face the same way (and probably held tip down, but this cannot be ascertained from the specimen as it cannot be orientated with confidence), and for their elongate cuspidate tips.

2. *Homalomena expedita* A. Hay & Hershovitch, *sp. nov.*

Ab aliis speciebus *Homalomenae* in habitu stolonifera, heliophila, paludicola, inflorescentia solitaria, spadice cum interstitio nudo longo verruculoso differt. — **Typus:** Cult. RBG Sydney Acc. No. 940562 ex Malaysia, Sarawak, Lundu, near bridge on Kuching Road (orig. coll. Hay, Yahud, Saupe & Chan 9409), C. Hershovitch s.n. (NSW, holo; iso SAR).

Figures 2 & 3

Colony-forming stoloniferous herb to c. 60 cm tall. *Stem* an erect to creeping rhizome to c. 30 cm long, c. 4 cm thick emitting cataphylliferous stolons to c. 40 cm long, 1 cm thick, these eventually upturned, becoming rhizomatous, leafy, emitting further stolons from the base of the rhizomatous portion. *Leaves* clustered, to c. 10 together; petiole to c. 45 cm long, somewhat spongy within, pale mid-green with broken darker green longitudinal striations, sheathing in the lower 1/3, with an anise odour when crushed; blade mid-green on both sides, glossy at first, becoming matt, very broadly ovato-sagittate, leathery, c. 15–20 cm long and wide, the apex broadly obtuse, very abruptly and shortly acuminate for c. 1 cm, finally stiffly apiculate for c. 3 mm, the base shallowly cordate to almost truncate, usually distinctly asymmetric, with widely spreading rounded to subtriangular posterior lobes 7–10 cm long; midrib adaxially flat, abaxially slightly prominent, with c. 5 adaxially impressed, abaxially slightly prominent primary lateral veins on each side (plus a cluster of 2 or 3 on each side running to the posterior lobes), alternating with fainter interprimaries and diverging at c. 60°. *Inflorescence* solitary; peduncle c. 7 cm long, rather thick, c. 8 mm diam., erect. *Spathe* green, c. 5 cm long, 1.5 cm across and in bud slightly inflated at level of female zone, thence subcylindric-tapering, but not constricted, later very narrowly ovoid, apiculate for c. 4 mm. *Spadix* stipitate for 6 mm, 4.5 cm long; female zone more or less cylindrical, 0.8–1.2 cm long (irregular length around circumference of spadix), 1.2 cm wide;



Figure 2. Homalomena expedita A. Hay & Herscovitch

Herscovitch s.n. – A. young shoot with runner; B. leaf blade outline; C. flowering shoot detail; D. inflorescence.

Scale: bar to A, B = 12 cm, to C, D = 7.5 cm.

pistils subglobose, 1–2 mm diam.; stigma sessile, discoid or very weakly 2–3-lobed, slightly narrower than the ovary, papillate; infrapistillar staminodes absent; sterile interstice conspicuous, 1.5 cm long, naked, pale green and c. 6 mm diam. in the lower 1 cm, with more or less regular spirals of low domed warts c. 0.5 mm diam., the upper part (comprising the base of the male zone) 9 mm diam., ivory and clothed in irregular sterile stamens; fertile male zone elongate-bullet-shaped, 1.5 cm long, tapering to a blunt acute tip, ivory; male flowers irregular (1–)2–4-staminate; stamens truncate, irregular in size, 1–1.5 mm across, irregularly polygonal, slightly sinuous on the abaxial side, the thecae overtopped by connective. *Fruit* unknown.

Distribution: Malesia: endemic to Borneo (Sarawak); known from the type locality and sighted near Sibu along the main road to Miri.

Habitat: Forming large, probably clonal colonies in open swamps and ditches at low elevation, sometimes in tidal mud with *Cryptocoryne ciliata* (Roxb.) Schott and mangroves.

Notes: The spadix of *Homalomena expedita* is unique in the genus, having a very conspicuous naked warty interstice above the female zone as well as a zone of sterile stamens at the base of the male zone. *Homalomena expedita* is also very remarkable, in this genus of shade-loving terrestrial and rheophytic plants, for its occupation of open swampy sites, even tidal mudflats, in full sun. It appears to spread rapidly through the production of stolons, and is certainly very vigorous (though seldom-flowering) in cultivation when provided with large amounts of nutrients. At Lundu it forms dense swards in shallow muddy ponds and from a distance rather resembles water hyacinth (*Eichhornia*). It appears less vigorous, though nonetheless invasive and persistent, in tidal, brackish conditions.

This species, in relation to the rest of its genus, is rather analogous to the open swamp-dwelling, colony-forming *Aglaodorum*, contrasted with *Aglaonema* (both *Aglaonemateae*). Both *Homalomena expedita* and *Aglaodorum griffithii* Schott, besides their similar habitat preferences, produce solitary inflorescences where their immediate forest-dwelling, non-proliferating relatives generally produce complex synflorescences (except in some of the most diminutive species).

In addition to the reduced number of inflorescences, it seems, on the basis of limited observations of *H. expedita* in cultivation, that there is other evidence pointing to depressed or suppressed sexual fertility: we have never observed the spathe to open (but we are at present unable to

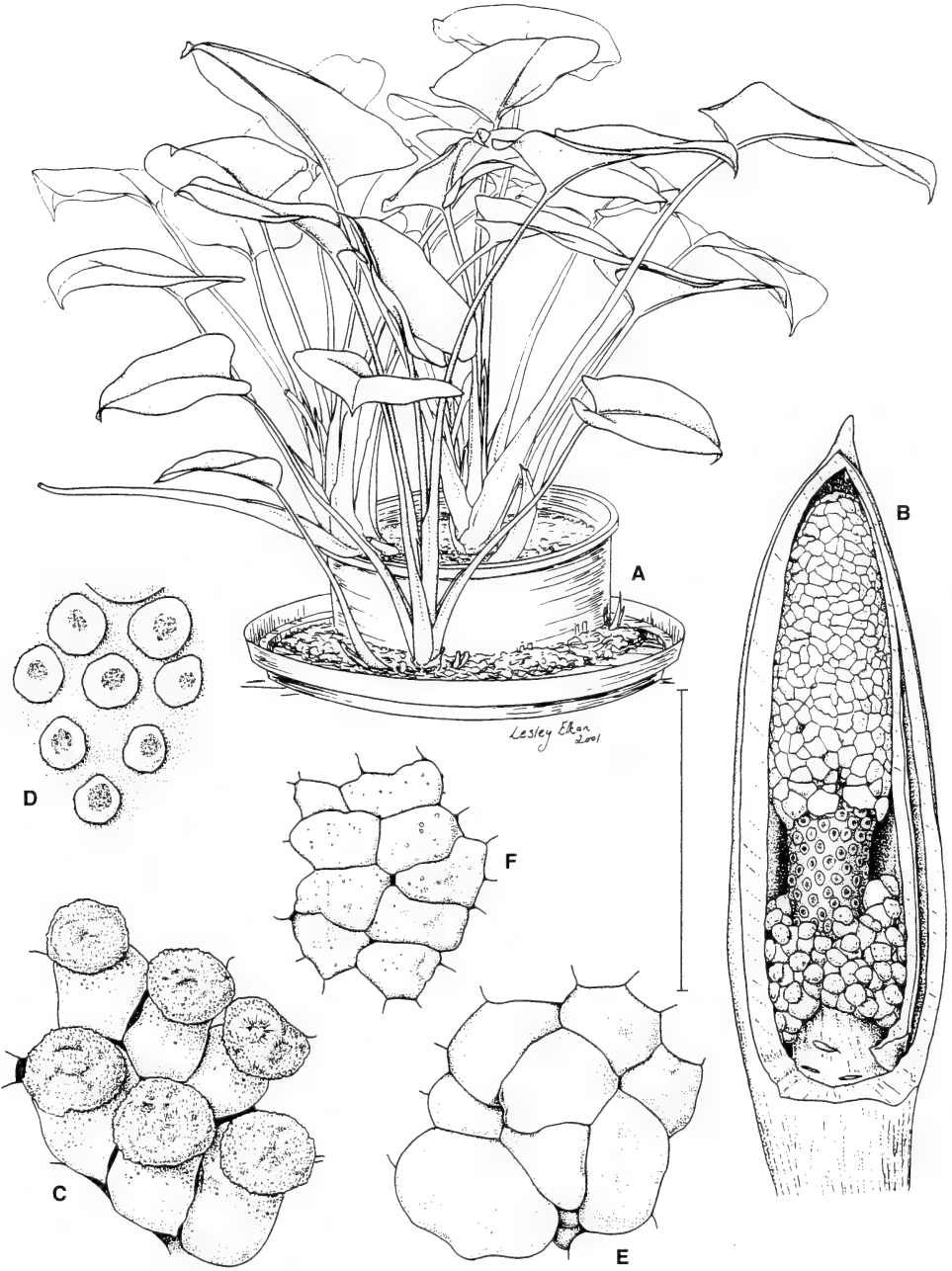


Figure 3. Homalomena expedita A. Hay & Herscovitch

Herscovitch s.n. – A. habit of cultivated plant; B. spadix; C. pistils; D. abortive pistils on interstice; E. sterile stamens from lower part of male zone; F. stamens from upper part of male zone.

Scale: bar to A = 18 cm, to B = 2 cm, to C, D & E = 6 mm.

verify that it remains closed throughout the flowering process); the papillae on the interstice appear to be abortive pistils; the staminal thecae contain some pollen, but are partially empty in most anthers; senescent male flowers appear not to have shed pollen; the ovaries however, are filled with ovules which appear normal in form.

The leaf, very broadly ovate with a near-truncate cordate base, is similar to that of *H. havilandii* Ridl., also from Sarawak, but that species does not share the habit and habitat preference of *H. expedita* nor the prominent sterile interstice of the spadix.

The epithet means 'set free', or 'foot-loose', alluding to the departure from confinement to shaded conditions otherwise typical for the genus, and the invasive, stoloniferous habit.

Acknowledgements

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Re-examination of *Vaccinium dialypetalum* (Ericaceae)

S.P. VANDER KLOET

Department of Biology, Acadia University, Wolfville
Nova Scotia B0P 1X0, Canada

Abstract

Morphological re-examination of *Vaccinium dialypetalum sensu lato* supports the view that it includes three distinct taxa: *V. dialypetalum* J.J.Sm., *V. micranthum* (Ridl.) Vander Kloet and *V. perakensis* (Ridl.) Vander Kloet, all first described by Ridley under *Agapetes* but transferred by Sleumer to *Vaccinium*. Keys and descriptions are provided to distinguish the three taxa and new combinations are made for two taxa.

Introduction

Ridley (1923) recognized three species of *Agapetes* (Ericaceae) based on their distinct floral development patterns. In all three species, floral axis development is sequential. First, the rachis emerges from the perennating bud, followed by the development of the pedicel and calyx tube at the first node (indicated by a tiny bract on the rachis) and finally the corolla, style and stamens are initiated. Thus in *A. perakensis* Ridl., the rachis and pedicels continue to lengthen and thicken in tandem until anthesis when rachis growth stops but the pedicel continues to elongate until the fruit ripens, producing a rachis 3–5 cm long with many pedicels 1–2 cm long. In *A. micrantha* Ridl., the development of the rachis is arrested but the pedicels continue to lengthen and thicken until the berry is ripe, resulting in a slender, 3-flowered rachis but *A. wrayii* Ridl., has a short stout rachis bearing many flowers on long pedicels that continue to elongate as the fruit matures.

Sleumer (1967) did not recognize these differences as significant and united them into a single species, *Vaccinium dialypetalum* J.J. Sm. While Sleumer's transfer of Ridley's three *Agapetes* species to *Vaccinium* § *Galeopetalum* (J.J.Sm.) Sleumer is widely accepted, his broad species concept of *V. dialypetalum* was called into question when Ng (1976) separated specimens with shorter calyx lobes and stamens with glabrous filaments and short dorsal spurs as a new species, *V. pseudodialypetalum*. This latter species is, however, identical with Ridley's *Agapetes micrantha*.

Indeed, to place all three taxa in *V. dialypetalum* is quite untenable since at least two qualitative features separate each taxon, viz., corolla shape and stamen architecture separate *V. micrantha* from *V. dialypetalum*

and *V. perakensis*, whilst anther fusion and the shape of the staminal awns separate *V. perakensis* from *V. dialypetalum*. This morphological gap is sufficient to recognize each of Ridley's taxa at the specific level.

Taxonomic Treatment

Vaccinium § **Galeopetalum** (J.J.Sm.) Sleumer, Notizbl. Berlin-Dahl. 13 (1936) 115. Subgenus *Galeopetalum*, J.J.Sm. Icones Bogoriensis 4 (1912) 101. **Type:** *Vaccinium dialypetalum* J.J.Sm.

In Malesia, according to Sleumer, this section is restricted to northern Sumatra and adjacent Peninsular Malaysia. Species, such as *V. petelottii* Merr., *V. lanigerum* Sleumer, and *V. dunalianum* Wight from northern Vietnam, adjacent Yunnan and the Tibet-Burma border, have also been referred to this section by Stevens (1969). However, Vander Kloet and Paterson (2000) found that *V. petelottii* is genetically quite similar to *V. tonkinense* Dop of sect. *Conchophyllum* Sleumer, hence Stevens' extension of sect. *Galeopetalum* into SE Asia needs to be reassessed.

Keys to Identify Malesian Taxa of *Vaccinium* § *Galeopetalum*

Key for flowering material

- Corollas globose; calyx lobes shorter than the tube; stamens c. 1 mm long 2. *V. micrantha*
 Corollas campanulate; calyx lobes much longer than the tube; stamens 3–4 mm long
 Anthers fused 1. *V. dialypetalum*
 Anthers free 3. *V. perakensis*

Key for fruiting material

- Rachis much shorter than the pedicels 1. *V. dialypetalum*
 Rachis as long as or much longer than the pedicels
 Rachis 1–2 cm long, fruits per raceme 3 or fewer ... 2. *V. micrantha*
 Rachis 3–10 cm long, fruits per raceme 4 or more . 3. *V. perakensis*

1. **Vaccinium dialypetalum** J.J.Sm. *Icones Bogoriensis* 4 (1912) 99, t. 331.

Type: Indonesia, Java (cult.) *Rant & Smith 513* in 1911. (holo, BO).

Synonyms: *Agapetes pubescens* Ridl., *J. Bot.* 62 (1924) 298. **Type:** *Burkill & Holttum 7828* (SING); *A. wrayii* Ridl., *Fl. Malay Pen.* 2 (1923) 205.

Type: *Wray 8054* (SING);

Vaccinium longipes Sleumer, *Bot. Jahrb.* 71 (1941) 424. **Type:** not seen.

Epiphytic shrub with a well-developed tuber; stems 2 or 3, sinuous, 1–3 m long; innovations initially reddish and pubescent; leaves ovate-lanceolate, narrowly acuminate, 6–12 x 1.5–4.5 cm, margin entire, petioles 1–2 mm long; racemes axillary, 6–10-flowered; rachis much shorter than the pedicels; pedicels 2–4 cm long articulated with the calyx tube; calyx lobes longer than the tube at anthesis; corolla campanulate, whitish-green, 6 mm long, 7 mm in diameter, 5-lobed, lobes 4–5 mm long; stamens 7 mm long, anthers fused into ring, awns and tubules well developed; style glabrous, slender 6–7 mm long; berry black, 7–9 mm diam., seeds many and small.

Distribution and ecology: Northern Sumatra and Peninsular Malaysia (Main Range), in montane forests 900–1300 m altitude.

2. **Vaccinium micranthum** (Ridl.) Vander Kloet, **comb. nov.**

Type: Malaysia, Selangor, Sempang Mines, *Ridley 15768* (1911). (holo SING!).

Basionym: *Agapetes micrantha* Ridl., *Fl. Malay Pen.* 2 (1923) 205.

Synonyms: *A. parviflora sensu* Ridl., *J. Roy. As. Soc. S. Br.* 61 (1912) 26 non *A. parviflora* Dunn; *Vaccinium ridleyii* Sleumer, *Bot. Jahr.* 71 (1941) 424. **Type:** *Ridley 15768* (SING); *V. pseudodialypetalum* Ng, *Gard. Bull. Sing.* 28 (1976) 233. **Type:** *KEP 56673*.

non *Vaccinium parviflorum* Andrews, *Bot Rep.* (1800) t. 125 = *Gaylussacia resinosa* (Aiton) T & G.

Epiphytic shrub with a well-developed tuber; stems 2 or 3, slender, sinuous 1–2 m long; innovations initially reddish and softly pubescent; leaves deltoid-ovate, long caudate, 6–8 x 3–4.2 cm, margin entire, petioles 1–2 mm long; racemes slender, 3-flowered, often obscured by the leaves; rachis 1–2 cm long; pedicels 1–2 cm long, calyx lobes shorter than the tube; corolla globose, greenish-white, 3 mm long, 3–4 mm diam., 5-lobed; stamens 1 mm long, anther tubules and awns vestigial; style stout, glabrous, cylindrical, 3 mm long; berry black, 8–9 mm diam.; seeds small, 25–40; testa pale brown.

Distribution and ecology: Known only from Peninsular Malaysia (Pahang and Selangor), in montane forests between 1000–1600 m altitude.

3. **Vaccinium perakensis** (Ridl.) Vander Kloet, **comb. nov.**

Type: Malaysia, Perak, Taiping, Maxwell's Hill, 750–1200 m altitude. Ridley 5532 (holo SING!).

Basionym: *Agapetes perakensis* Ridl., Fl. Malay Pen. 2 (1923) 205.

Synonyms: *A. griffithii sensu* K&G, J. As. Soc. Beng. 74 (1905) 59 non C.B. Clarke in Hook.f. **Type**: King 6363 (SING); *Vaccinium longilingue* Sleumer, Bot. Jahr. 71 (1941) 424. **Type**: Ridley 5532 (SING); *V. urophyllum* Merr., Pap. Mich. Ac. Sc. 19 (1934) 184. **Type**: King 6363 (iso SING).

Epiphytic shrub with a well-developed tuber; stems few, slender and sinuous, up to 5 m long; innovations reddish and pubescent, rarely glandular; leaves ovate-lanceolate and often caudate, 8–14 x 2.2–5.5 cm wide, margin entire, petioles 2–3 mm long; racemes axillary, well-developed, glabrous, pubescent or glandular, 5–15 flowered; rachis invariably longer than the pedicels; pedicels 1–3 cm long, calyx lobes as long as or longer than the tube at anthesis; corolla campanulate, slightly 5-angled, creamy white often pink inside, 5–6 mm long, obtusely 4 or 5 lobed; stamens c. 6 mm long, anthers free, with 2 dorsal spreading and ultimately upwardly curved echinate arms, tubules slender and erect; style slender and glabrous, 6–7 mm long; berry reddish-black, often pubescent, 7–9 mm diam., seeds small, testa blackish.

Distribution and ecology: Northern Sumatra and Peninsular Malaysia, where it is uncommon, in montane forest, or riverine at lower elevations, 600–1200 m altitude.

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Limau Hantu and Limau Purut: the Story of Lime-Leaves (Citrus hystrix DC., Rutaceae)?

D. J. MABBERLEY

Nationaal Herbarium Nederland, University of Leiden, The Netherlands;
Royal Botanic Gardens Sydney,
Mrs Macquaries Road, Sydney 2000, Australia*

Abstract

Limau purut (*Citrus hystrix* DC.), cultivated throughout SE Asia, appears to be a selected form of the wild *limau hantu* (*C. macroptera* Montr., i.e. *C. auraria* Michel), though its earliest scientific name may be *C. fusca* Lour. Complete synonymy with types is presented in a provisional arrangement of 'wild' plants and cultivars. Suggestions for further work on *C. hystrix* and its relations with other cultivated citrus are made. X *Citroncirus* is formally reduced to *Citrus* and a new name proposed for the citrange root-stock, **Citrus x insitorum** Mabb. A diagram of the relationships through hybridity of cultivated citrus is presented.

Introduction

Characteristic of Thai cooking, worldwide, are lime-leaves (*limau purut*, *Citrus hystrix* DC.), chopped fine better to release their oils. The fruits are not used for food, because, unlike those of species and hybrids placed in 'subg. *Citrus*', those of *C. hystrix* and other species placed in 'subgen. *Papeda* (Hassk.) Swingle' are almost inedible due to the acrid oil in the vesicles surrounding the seeds (Mabberley, 1997). They have been used medicinally, and in Sri Lanka the English name is leech-lime because they are used as a leech-repellent. In the Malay Peninsula the fruits were a soap substitute and sold for this purpose (Burkill, 1931), a practice still prevalent in Cambodia (Boeun Sok, Royal Botanic Gardens Sydney, *pers. comm.*) and elsewhere in SE Asia.

Limau purut and limau hantu

A plant of *limau purut* grown in Ambon, Indonesia, was drawn for Rumphius (1628–1702) and specimens were collected 1771–2 by Pierre Sonnerat (1748–1814) in the 'Indes' and noted some decades later in Lamarck's *Encyclopédie méthodique* (1796). It was first grown in Europe at the end of the eighteenth century when it was introduced to France, by an amateur, from Mauritius, where it was being cultivated. A fruit was given to a M. Rol[and], through whom a plant reached the botanic garden

*Address for correspondence

in Montpellier, France, in 1808. However, it did not flower for many years and it was formally described in the sterile state in 1813 (as '*C. hystrix*'). By 1816 it was in the trade, being grown by the Audibert nursery at Tonelle, near Tarascon (Michel, 1816: 42, t. 18).

In cultivation in Singapore and elsewhere today are forms differing in the amount of tothing of the lamina and the degree of roundedness of its apex, but these features can vary markedly within a single cultivated plant (*pers. obs.*). The pericarp of the fruit is generally somewhat lumpy in appearance. A form with a particularly lumpy pericarp is known as var. *torosa* (Blanco) Merr. and was also described from a cultivated plant, grown in the Philippines.

In recent accounts, these cultivated plants have been considered allied to, but distinct from, *C. macroptera* Montr., described from New Caledonia though not native there. *Citrus macroptera*, which was also figured by Rumphius (the plate being the basis of *C. auraria* Michel, an apparently overlooked earlier name* for *C. macroptera* - see below), is found throughout Malesia, and in Peninsular Malaysia it is known as *limau hantu*. On the whole, such plants tend to have rather more acute leaf apices. Having examined a wide range of material of *limau hantu* and *limau purut* held at BM, F, K, L, NSW, P, PNH, SING and UC, US, however, I am forced to conclude that the cultivated plants called *limau purut* appear to be merely selected forms (cultivars) of *limau hantu*.

This conclusion is not original: Merrill (1923), studying just the Philippine material available to him, amalgamated the 'species', though he used varietal rather than cultivar status for the pomological forms. Moreover, the 'wild' plants throughout their range were formally included in *C. hystrix* by Engler and Harms (in Engl., Nat. Pflanzenfam. Ed. 2, 19a: 336, 1931), but these authors have not generally been followed in recent floristic accounts.

The state of affairs is somewhat comparable with that of the cultivar 'Etrog' of *Citrus medica* L., the citron. That cultivar was first formally described as *C. tuberosus* Mill. and has a markedly tuberculate berry surface like *limau purut*, compared with the smoother-skinned 'typical' forms of *C. medica* similar to those in *limau hantu*. Many forms of citrus with lumpy or grotesquely formed fruits were also selected in Europe, notably in Italy, and were fashionable in the orangeries of the rich where they were known as 'agrumi'.

Another ancient cultivar of *C. medica*, for example, is 'Fingered' (the 'Buddha's hand'), where the fruit is split into a number of finger-like sections. Because of its form, in the past it has been afforded not merely varietal (var. *sarcodactylis* (Noot.) Swingle) and specific (*C. sarcodactylis*

*As are his *Citrus ventricosa* (see below) and *Citrus mammosa* and *C. nipis* Michel, *Traité Citronier*: 44 (1816) and in Duhamel, *Traité Arbres Arbustes* 7:111 (1819)=*C. medica* L. & *C. x aurantiifolia* (Christm.) Swingle, respectively.

Noot.) ranks, but even accommodated in a separate genus (as *Sarcodactilis helicteroides* Gaertn.f.)!

A Provisional Classification for Wild and Cultivated Forms of *Citrus hystrix*

Note: names not found in Index kewensis or other lists are marked with an asterisk.

Citrus hystrix DC., Cat. Hort. Monsp.: 19, 97 ('*hystrix*', 1813); Michel, *Traité Citronier*: 42, t. 18 (1816) & in Duhamel, *Traité Arbres Arbustes* 7:108, t. 39 fig 1 ('*hystrix*', 1819); DC., *Prodr.* 1: 539 (1824); Merr., *Enum. Phil. Fl. Pl.* 2: 342 (1923) excl. var. *macrophylla* (Wester) Merr. [cf. *C. maxima* (Burm.) Merr. or *C. x aurantium* L. Grapefruit group]; Guillaumin in Gagnep., *Suppl. Fl. Gén. Indochine*: 653 (1946); Staples & Kristiansen (1999: 27–9), q.v. for description. - *C. echinata* St-Lag. in *Ann. Soc. Bot. Lyon* 7: 122 (1880), *nom. superfl.*

Type: cultivated in Montpellier, France, "Frutex spectabilis [N.B. It was sterile when first described and had still not flowered by 1824 (DC., l.c.)] olim ex insula Mauritiana (ubi forsans cultus) merit. Mercatori Nemausensi [a merchant of Nimes, France] Roland a navarcha quodam allatus, et anno 1808 a D^o. Roland horto Monspeliensi humanissime missus" (G-DC fiche! 'de M. Roland', holo?).

(Northeastern India and southern China?), Burma and Thailand to Sumatra, east to New Guinea, though natural distribution probably obscured by cultivation, its having been carried far into the Pacific (A.C. Smith, *Fl. Vitiensis Nova* 3: 186, 1985), for example. Selected forms are cultivated throughout the warm parts of the world for culinary (leaves - lime-leaves) and medicinal (fruit - leech-lime) use. Indeed all named taxa seem to have been based on cultivated plants, though perhaps the type of *C. celebica* and some other Philippine taxa were truly wild ones.

As with *Clerodendrum chinense* (Osb.) Mabb. (Labiatae), *Cupressus lusitanica* L. (Cupressaceae), *Kerria japonica* (L.) DC. (Rosaceae), *Rhododendron stenopetalum* (Hogg) Mabb. (Ericaceae; Mabberley, 1995) and *Melia azedarach* L. (Meliaceae; Mabberley, 1984), for example, the name *C. hystrix* covers both the wild plant and the cultivar (the type, so far apparently without a formal cultivar name, though Guillaumin's name for it among his 'formes culturales' [in Lecomte, *Fl. Gén. Indochine* 1: 676, 1911, under *C. aurantium*] could be construed as such, though being 'Hystrix', this would not be allowed by the Cultivated Code [Art. 25.2]). It

is notable that the scrappy type at G-DC has leaflets rather more acute than is seen in many cultivated specimens. The only cultivar name published for any plant referable to this group seems to be 'copahan' (see below).

The plants are arranged below as 'wild' (*limau hantu*) followed by *limau purut* (lime-leaves) and other cultivars.

'Wild' plants (*limau hantu*)

[*Lemoen Amâs* Valentijn, Amboina 3(1): 190 (1726)]

**Citrus auraria* Michel, *Traité Citronier*: 43 (1816) & in Duhamel, *Traité Arbres Arbustes* 7:109 (1819). - [*Limonellus aurarius* Rumph., *Herb. Amb.* 2: 109, t. 30 (1741)] - *C. limetta* Risso var. *auraria* Risso in Risso & Poit., *Orangers*: t. 59 (1818).

Type [icon]: Rumph, *Herb. Amb.* 2: t. 30 (1741).

Citrus macroptera Montr. in *Mém. Acad. Lyon* 10: 187 (1860). - *C. combara* Raf. var. *macroptera* (Montr.) Tanaka in *J. Soc. Trop. Agric.* 10: 352 (1938) & *Stud. Citr.* 9:2 (1939).

Type: New Caledonia, Ile Art "juxta domos indigenarum", *Montrouzier s.n.* (LY, lost [F, photo!]).

Citrus celebica Koord. in *Meded. 'sLands Plant.* 19: 370, 839 (1898).

Type: Indonesia, Sulawesi, Minahassa, Manado, 250-275m, *Koorders 18751β* (BO, holo-, n.v.; K!, P!, PNH!, iso-).

Citrus papuana F.M. Bailey in [*Ann.*] *Rep. Brit. New Guinea* 1901-2: 1 (1902) & *Contrib. Fl. Brit. New Guinea*: 1 + t. (1903).

Type: Papua New Guinea, Milne Bay, *Le Hunte s.n.* (BRI, n.v. holo?; P, fragm!).

Citrus x aurantium L. subsp. *saponacea* Saff. in *Contrib. U.S. Nat. Herb.* 9: 226 (1905), *e descr.*

Type: [Guam, cult.] not indicated.

Citrus southwickii Wester in *Phil. Agr. Rev.* 8: 16, tt. 3c [*'C. limao'*], 4c (1915). - *C. hystrix* DC. var. *southwickii* (Wester) Merr., *Enum. Phil. Fl. Pl.* 2: 343 (1923). - *C. macroptera* Montr. var. *southwickii* (Wester) Tanaka in *Trans. Nat. Hist. Soc. Formosa* 22: 430 (1932). - *C. celebica* Koord. var. *southwickii* (Wester) Swingle in *J. Wash. Acad. Sci.* 28: 533 (1938).

Type: Philippines, cult. Luzon, Lamao, Mar 1915, *Wester* 2049 (PNH†, holo?; K!, PNH!).

Citrus hystrix DC. var. *boholensis* *Wester* in *Phil. Agr. Rev.* 8: 19, tt. 4a, 5a (1915). - *C. macroptera* Montr. var. *boholensis* (*Wester*) *Tanaka* in *Trans. Nat. Hist. Soc. Formosa* 22: 430 (1932). - *C. combara* Raf. var. *boholensis* (*Wester*) *Tanaka*, *Stud. Citr.* 9: 3 (1939). - **C. boholensis* (*Wester*) *Tanaka*, *Syst. Pomol.* : 140 (1951), nom.nud., **synon. nov.**

Type: Philippines, Bohol, cult. Lamao, Mar. 1915, *Wester* 2525 (PNH†, syn?; PNH!, isosyn.), Bohol, cult., 1914, *Wester* 4824 (PNH†, syn?; PNH! isosyn).

Citrus vitiensis *Tanaka* in *Bull. Soc. Bot. Fr.* 75: 715 (1928).

Type: Fiji, Viti Levu, Namoso/Namura R., 1866, *Seemann* 58 (K!, holo [F, photo!]; BM!, P!, iso).

Citrus macroptera Montr. var. *annamensis* *Tanaka* in *Bull. Mus. Hist. Nat. Paris* II, 2: 164 (1930). - *C. hystrix* DC. var. *annamensis* (*Tanaka*) *Guillaumin* in *Gagnep., Suppl. Fl. Gén. Indochine*: 654 (1946) .

Type: Vietnam, massif Cô Inh, près de Nhatrang, 18 Sept. 1922, *Poilane* 4650 (P!, holo [F, photo]; UC!).

Citrus macroptera Montr. var. *kerrii* *Swingle* in *J. Wash. Acad. Sci.* 32: 34 (1942) - **C. kerrii* (*Swingle*) *Tanaka*, *Syst. Pomol.*: 140 (1951), **synon. nov.**

Type: Thailand, Nalawn Sawan, Kampeng Pêt, Mê Lamung, 7 June 1922, *A.F.G. Kerr* 6081 (ABD, holo; BM!, K!, iso)

Rumphius (l.c.) discussed the disarticulating of the lamina from the broad winged petiole and the use of the fruit in washing, recording that it occurs in Sulawesi and that it is the Lemoen Amâs of Valentijn. It should be noted that although the plants arranged above resemble morphologically the presumed wild ancestor of the cultivars below, several of them are described from plants in cultivation, often far beyond the putative natural range, and in that sense are perhaps cultivars in their own right. The concept of 'wildness', so obscured in cultivated plants such as these, is clearly linked to human perceptions of human actions as somehow 'above' or 'different from' the dispersal activities of other animals' selecting 'superior' forms in terms of fruit or seed size, colour, taste, texture, etc. and is therefore perhaps an inappropriate one (Mabberley, 1999).

N.B. Merrill (1917) suggested that yet another plant described and figured by Rumphius should be referred to *C. hystrix* (i.e. Herb. Amb. 2: t. 26 f. 3), for which the flowers and leaves look right, but not the fruit (cf. *C. ventricosus* below, where the opposite is true). Moreover Burkill (1931) also referred to it, the Indochinese '*C. cavalierei* Léveillé', a *nomen nudum*, and the Chinese *C. ichangensis* Swingle, of which var. *latipes* Swingle has been given specific rank as *C. latipes* (Swingle) Tanaka.

However, there are a number of more distinctive taxa, all apparently certainly cultivars, the first now widely spread in the Old World Tropics, the others grown principally in central Malesia, notably the Philippines.

'Copahan' (and unnamed cultivar[s]?) - *limau purut*, lime-leaves, makrut lime, leech lime, kaffir lime)

Citrus hystrix DC. 'Copahan', Wester in Phil. Agric. Rev. 8: t. 5b (1915).

Citrus hystrix DC. (1813), *sensu stricto*. - *C. limetta* Risso var. OC Risso & Poit., Hist. Nat. Orangers: 123 (1819). - *C. aurata hystrix* Risso, Hist. Nat. Eur. Medit. 1: 409 (1826). - *C. x aurantium hystrix* Jacquemont-Bonfont, Cat. Prix Courants: 51 (1833). - *C. x aurantium L. hystrix* ['forme culturale'], Guillaumin in Lecomte, Fl. Gén. Indoch. 1: 676 (1911).

[*Lemoen Porot* Valentijn, Amboina 3(1): 189 (1726)]

?*Citrus fusca* Lour., Fl. Cochinch: 467 (1791).

Type: not found (see below).

Citrus decumana L. '4. Le citronnier de Combara ou citron à la grecque' Poir. in Lam., Enc. Méth. 4: 580 (1796), **synon. nov.** - *Citrus combara* Raf., Fl. Tell.: 142 (1838) *e descr.*, **synon. nov.** - *C. macroptera* Montr. var. *combara* (Raf.) Tanaka in J. Ind. Bot. Soc. 16: 238 (1937) *nom. superfl. pro var. annamensis*.

Type: [Indes, *Sonnerat s.n.*], (P-LAM!).

?**Citrus ventricosa* Michel, Traité Citronier: 43 (1816) & in Duhamel, Traité Arbres Arbustes 7:109 (1819); - [*Limo ventricosus* Rumph., Herb. Amb. 2: 102 (1741)] - Risso in syn. *C. x bergamia* Risso & Poit. var. *ventricosa* M. Roem., Fam. Nat. Syn. Monogr. 1: 61 (1846, *nom superfl.* (*C. limetta* var. *auraria* Risso in syn.)).

Type: not indicated. Note that Rumphius's associated plate (t. 26 fig 2, 1741) does not match his (or Michel's) text at all and apparently represents the sambal, *C. amblycarpa* (Hassk.) Ochse, a plant whose relationships are as yet unclear.

Papeda rumphii Hassk. in Flora 25, Beibl. 2: 42 (1842). - *Citrus papeda* Miq., Fl. Ind. Bat. 1(2): 530 (1859), non *C. rumphii* Risso ('*rumphii*', 1844), i.e. *C. x aurantium* L. cv. - [*Limo agrestis* Rumph., Herb. Amb. 2: 104, t. 27 (1741)].

Type [icon]: Rumph., Herb. Amb. 2: t. 27 (1741).

**Citrus tuberoides* J.W. Benn., Sel. Rare Fr. Ceylon: t. 1 (1842) & Ceylon: 142 [tt.] (1843).

Type: not indicated. The plate should serve as iconotype in the absence of any specimen found.

Citrus x bergamia Risso var. *unguentaria* M. Roem., Fam. Nat. Syn. Monogr. 1: 61 (1846). - [*Limo unguentarius* Rumph., Herb. Amb. 2: 103, t. 26, fig 1 (1741)].

Type: not indicated.

The commonly seen cultivated plants tend to have more rounded leaf apices and bumpier fruit than the 'wild' forms do. It is possible that a number of distinctive cultivars, so far none named, are included here. Rumphius described the use of his *Limo agrestis* as a condiment, and both *Limo unguentarius* and *Limo ventricosus* for shampooing and washing, for example.

Notes: *Citrus fusca* Lour. may be an earlier name for *C. hystrix*. Loureiro cited a Rumphian plate (Herb. Amb. 2: t. 33, 1741) which is referable to *C. x aurantium* L. Bitter Orange group, so that later authors have referred *C. fusca* to that. However he said that it is widespread in 'Cochinchina' but rarer in China and described its contorted branches, its unpleasantly scented leaves, the characteristic wide petiole and rough green-brown fruits, all typical of *C. hystrix*, and discusses the medicinal properties of the peel. As no Loureiro specimen is known, it is perhaps best to consider it a *nomen dubium*: if it should prove conspecific, it will be in the interests of nomenclatural stability to propose its rejection.

Citrus combara Raf. appears to be based on information in Lamarck's *Encyclopédie Méthodique*, hence its specific epithet and placement here.

'Torosa' (kolobat)

Citrus torosa Blanco, Fl. Filip.: 609 (1837); cf. Merr., Sp. Blanc.: 204 (1918).
- *C. hystrix* DC. var. *torosa* (Blanco) Wester in Phil. Agric. Rev. 8: 19 (1915).

Type: Philippines. Luzon, Batangas Prov., Aug. 1914, Merrill, *Sp. Blancoanae* 46 (US [sheet 903713 'Sept. 1914' - Dan Nicolson *pers. comm.*], **neo, designated here** [Nicolson and Arculus (2001) have argued the case for the US set of Merrill's *Species Blancoanae* being considered as appropriate choices for neotypes]; F!, K!, L!, P!, iso).

'Balincolong' (balinkolong)

Citrus micrantha Wester 'Balincolong', Wester in Phil. Agric. Rev. 8: t. 7c (1915).

Citrus micrantha Wester in t.c. : 16, tt. 5c, 6b (1915). - *C. hystrix* DC. var. *micrantha* (Wester) Merr., Enum. Phil. Pl. 2: 343 (1923). - *C. macroptera* Montr. var. *micrantha* (Wester) Tanaka in Trans. Nat. Hist. Soc. Formosa 22: 430 (1932). - *C. combara* Raf. var. *micrantha* (Wester) Tanaka, Stud. Citr. 9: 3 (1939).

Type: Philippines, *Wester s.n.* (PNH †, photo F! [? = (Lamao), Mar. 1915, *Wester 2049* (P, ?iso!)]).

Citrus hystrix var. *balincolong* Tanaka in Trans. Nat. Hist. Soc. Formosa 22: 429 (1932). - *Citrus balincolong* Tanaka, Syst. Pomol.: 139 (1951), nom. nud. **synon. nov.**

Type: 'Philippines', Bohol, 1914, *Wester 4834* (PNH†; PNH, iso!).

A cultivar with small flowers. Although it was referred to *C. hystrix* by Merrill (1923), he conceded that it might be of hybrid origin: this has yet to be tested. I have seen material from only the Philippines so far.

'Samuyao sa Amoo' (samuyau)

Citrus micrantha Wester 'Samuyao sa Amoo', Wester in Phil. Agric. Rev. 10: t. 7d (1917).

Citrus micrantha Wester var. *microcarpa* Wester in op. cit. 8: 21, t. 7b (1915). - *C. hystrix* DC. var. *microcarpa* (Wester) Merr., Enum. Phil. Fl. Pl. 2: 343 (1923). - **C. westeri* Tanaka, Syst. Pomol.: 139-140 (1951, 'westerii'), non *C. x microcarpa* Bunge (1833), **synon. nov.**

Type: Philippines, *Wester s.n.* (PNH† [F, photo!]).

A cultivar with small leaflets and small aromatic fruits, which in overall appearance resembles the Chinese *C. ichangensis* included in the synonymy of *C. macroptera* by Burkill (1931).

Further work

The hypothesis above is that from a widespread 'wild' form (*limau purut*) a number of cultivars have been selected and that the greatest diversity of these is in central Malesia. With DNA techniques now available, it should be relatively easy to test this hypothesis and to show whether or not any of the cultivars has arisen through hybridization with other species.

It also needs to be ascertained whether *C. ichangensis* is conspecific with *C. hystrix* or not and, if it is, whether it would best be treated as a geographical subspecies of *C. hystrix*. According to Needham (1986: 375—6), *C. ichangensis* was crossed with *C. maxima* long ago to produce '*C. hsiangyuan*' (i.e. *C. wilsonii* Tanaka [1932], ? = *C. x junos* Sieb. ex Tanaka [1924]), a plant discussed in Han Yen Chih's *Chü Lu* of AD 1178.

If this is true, the value of recognizing *C. hystrix* and its allies as a distinct subgenus comes into question, particularly with the re-inclusion in *Citrus* of *Eremocitrus* Swingle, *Fortunella* Swingle and *Microcitrus* Swingle (Mabberley, 1998). Recent chemical work (Samuel *et al.*, 2001) has confirmed the close-knit nature of these plants and also brings back in *Poncirus* Raf., long excluded because of its trifoliolate leaves. Elsewhere in *Aurantieae* Rchb. (Citreae), e.g. *Luvunga* Wight & Arn. (Mabberley, 1998), there are also both unifoliolate and trifoliolate species. With the inclusion of *P. trifoliata* (L.) Raf., so comes in *x Citroncirus*, the last surviving of the hybrid genera recognized by Swingle and followers with a narrow generic concept:

Citrus L., Sp. Pl.: 782 (1753).

Type: *C. medica* L.

Poncirus Raf., Sylva Tell.: 143.

Type: *P. trifoliata* (L.) Raf. = *C. trifoliata* L.

X *Citroncirus* J. Ingram & H. Moore in *Baileya* 19: 171 (1975), **synon. nov.**
Type: x *C. webberi* J. Ingram & H. Moore, l.c., non *Citrus webberi* Wester
 (?= *C. hystrix*/*C. ichangensis* x *C. x aurantium* L.), = **Citrus x insitorum**
 Mabb., **nom. nov.**

Type [icon]: USDA Yearbook 1904: 228, tt. XI n. 716, XII f. 1-3 ('Rusk').

The new epithet means 'grafters' citrus' because this is the citrange, an important tristeza-resistant rootstock for citrus. The cross was first made in 1897 and cultivars include 'Morton' and 'Rusk', which were grown from the same individual fruit (Swingle 1948: 371).

Within the cultivated citrus, it is now possible to draw up a scheme linking putative wild species with their hybrid offspring and to point up where there are still uncertainties and areas for further analysis (Fig. 1). These include:

- What the putative unknown parent species of the lemon and the lime are
- Whether or not the Tahiti Lime (*C. x latifolia* Tanaka) is a cross between the lime and the lemon or citron
- Whether or not the Meyer lemon (*C. 'Meyeri'*) and sweetie (*C. limetta* Risso) are crosses between *C. x aurantium* and the citron (in which case they are cultivars referable to *C. x bergamia*) or the lemon.
- Where *C. amblycarpa* (sambal) fits in this scheme.

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Note added in proof: According to O. Gulsen & M.L. Roose (2001), 'Chloroplast and nuclear genome analysis of the parentage of lemons', *Journal American Horticultural Science* **126**: 210–215, the unknown parent (CITRUS SP 1 in Fig. 1) of *C. x limon* is *C. x aurantium*. If this is so, *C. x bergamia* is best treated as a cultivar group of *C. x limon* to which *C. x taitensis*, *C. x limetta* and *C. x 'Meyeri'* would also be referred as cultivar groups, if they have the lemon rather than the citron as a parent. Hybridization experiments should now be performed to confirm the DNA work.

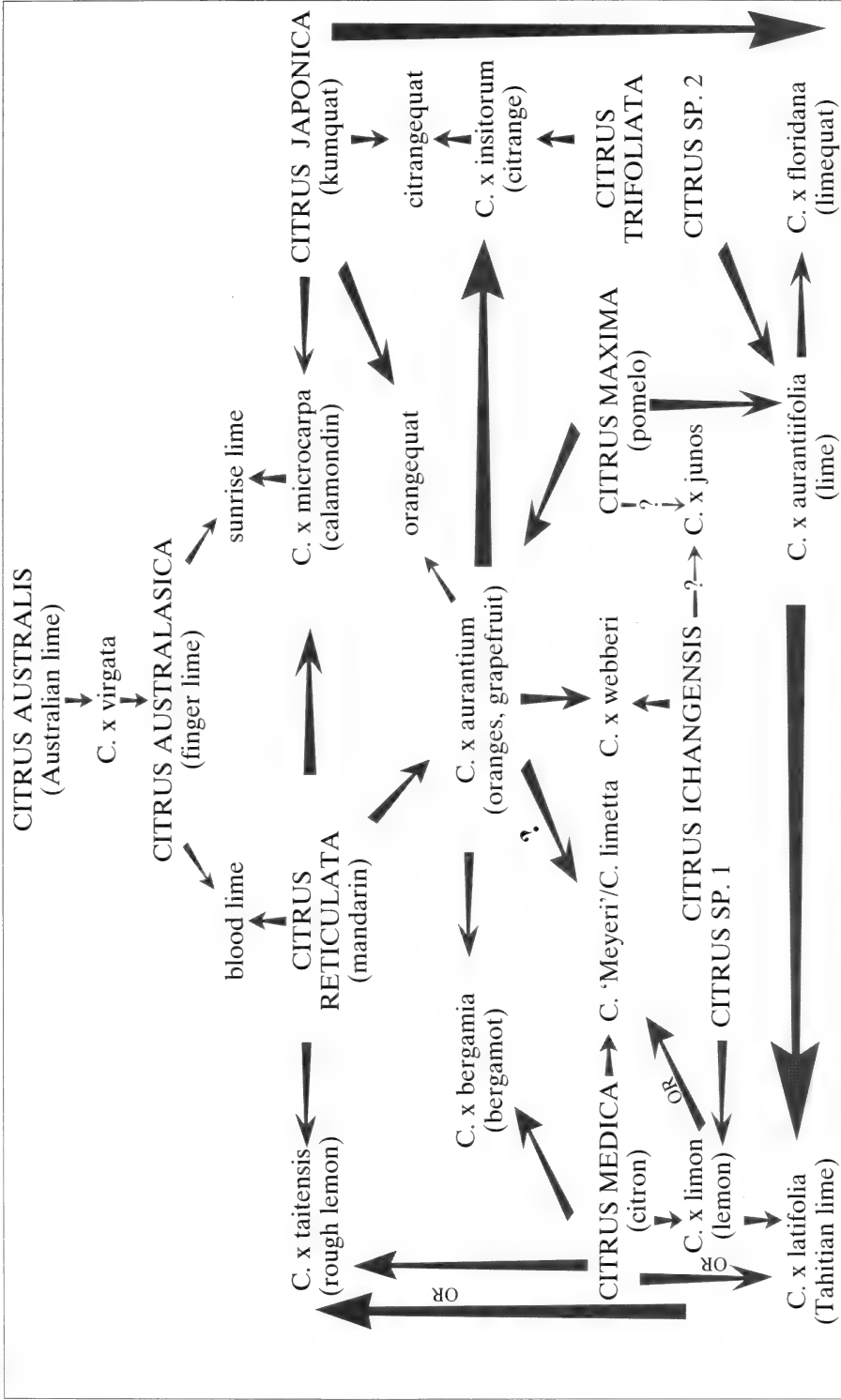


Figure 1. The relationships of cultivated citrus (based on materials from Mabberley 1997, 1998, 2001). Names of putative wild species are in block capitals, the arrows indicating their involvement in hybridization to give most of the commonly cultivated citrus fruits. (see 'Note added in proof')

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Two New Species of *Daemonorops* (Palmae) from Sumatra

HIMMAH RUSTIAMI

Herbarium Bogoriense, Jalan Ir. H. Juanda 22,
Bogor, Indonesia

Abstract

Two new species of *Daemonorops* (Palmae) from Sumatra are described and illustrated, *D. dransfieldii* Rustiami from Batang Palupuh, Bukit Tinggi, West Sumatra and *D. acehensis* from Takengon, Aceh.

Introduction

While working on a revision of *Daemonorops* sect. *Piptospatha*, I came across herbarium material of two new species from Sumatra. They belong to the dragon's blood group, a group within sect. *Piptospatha* known by the presence of red resin on the fruit scales. In all, 11 species have been described in this group (Beccari, 1911; Furtado, 1935; Burret, 1940; Dransfield, 1990).

Daemonorops dransfieldii Rustiami sp. nov.

Species nova a ceteris speciebus fructibus ellipsoideis, petiolis geniculatis singulariter plicatis differt. **Typus:** West Sumatra: Bukit Tinggi, Batang Palupuh, *J. Dransfield* 2757, 1972. (holo BO).

Figure 1 & 2

Clustering small rattan up to 6 m tall. Stems without sheaths up to 15 mm diam., with sheaths up to 25 mm diam.; internodes up to 150 mm long. Leaf sheaths green, covered with black, oblique spines joined at base, some bulbous-based, up to 3 cm long, sheath surface ridged with caducous black indumentum, leaf sheath mouth armed as the rest of sheath; knee conspicuous, singly plicate, armed as the rest of sheath. Leaves up to 3 m long including petiole to 25 cm, armed adaxially with short, erect, scattered spines up to 4 mm long, abaxially armed with erect, rarely solitary spines, up to 15 mm long; rachis unarmed, or armed only slightly proximally; cirrus up to 1.5 m long, armed with regularly arranged groups of grapnel-



Figure 1. *Daemonorops dransfieldii* Rustiami

A. Leaf sheath with young infructescence, B. Part of cirrus, C. Part of prophyll. All from Dransfield 2757.

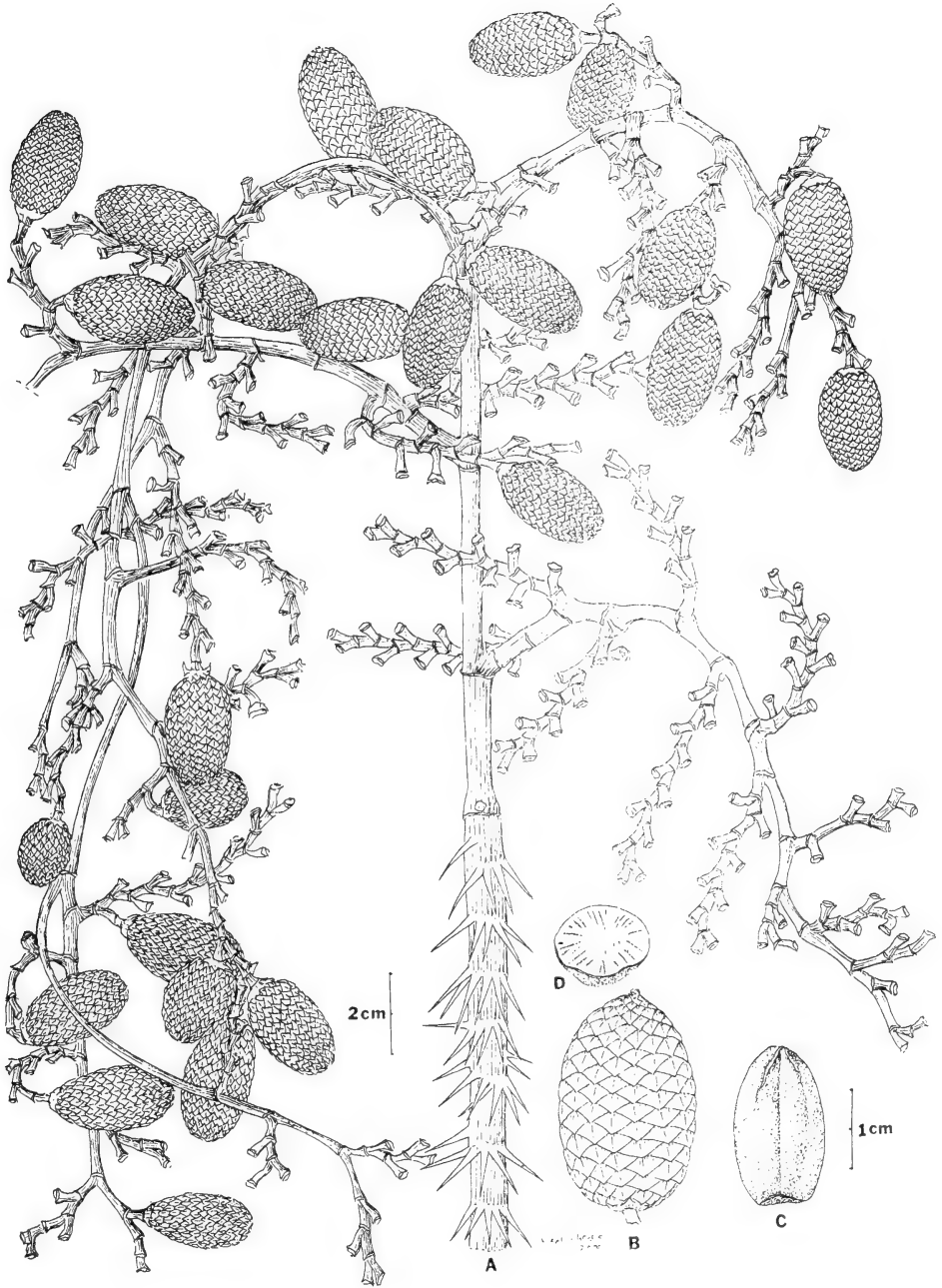


Figure 2. *Daemonorops dransfieldii* Rustiami

A. Inflorescence, B. Mature fruit, C. Seed, D. Seed in transverse section. All from J. Dransfield 2757.

like spines, blackish at the tip; leaflets mostly regularly arranged, slightly irregular above, 30 on each side of the rachis, stiff, horizontal; leaflets lanceolate, papery, acute, 25–31 cm long, c. 2.5 cm wide, armed with scattered, reddish, short bristles along the main nerve on both surfaces. Inflorescences pendulous to 35 cm long, peduncle 13–16 cm long, armed distally with groups of spines; peduncular bracts leathery, erect, c. 17 cm long, 3 cm wide, ellipsoid oblong, covered by rusty indumentum, armed with very rare, scattered spines; partial inflorescences 6, each bearing up to 11 rachillae; involucre pendulous, flat, just above the involucrophore, c. 5 mm long; involucrophore short, papery, c. 2 mm long. Female and male flowers unknown. Fruits broadly oblong, c. 2.5 x 1 cm, covered in 9 vertical rows of scales encrusted with reddish brown dragon's blood. Seed ovoid, c. 18 x 7 mm, surface smooth.

Distribution: Sumatra - known only from Batang Palupuh, Bukit Tinggi, West Sumatra.

Habitat: Found on a hill slope in disturbed forest at 800 m altitude.

Notes: Named in honour of John Dransfield, palm systematist who collected this species. *Daemonorops dransfieldii* differs from the other dragon's blood species by its broadly oblong fruit and singly plicate knee. The description is based only on the type specimen. As yet, this species is known to occur only in the Batang Palupuh area, but may be found elsewhere in West Sumatra if further fieldwork is carried out.

***Daemonorops acehensis* Rustiami sp. nov.**

Species nova a ceteris speciebus fructibus resinosis habitu parvo, vaginis foliorum spinulis confertissimis, longis erectis armatis et cirro non nisi usque ad 40 cm longo differt. **Typus:** North Aceh, Takengon, Burlintang, *J. Dransfield & D. Saerudin 2015, 1971* (holo BO).

Figure 3

Clustering small rattan up to 5 m tall. Stems without sheaths up to 10 mm diam., with sheaths up to 25 mm diam.; internodes up to 50 mm long. Leaf sheaths dark green, covered with black, very dense, single spines, up to 2.5 cm long, sheath surface covered with very dense black indumentum, leaf sheath mouth papery, armed as the rest of sheath, knee conspicuous, armed as the rest of sheath. Leaves up to 2 m long including petiole to 35 cm; abaxial and adaxial surfaces armed with long, erect spines to 3 cm long; rachis armed as petiole, sparsely covered with black indumentum; cirrus to 40 cm long, armed with regularly arranged groups of grapnel-like spines,

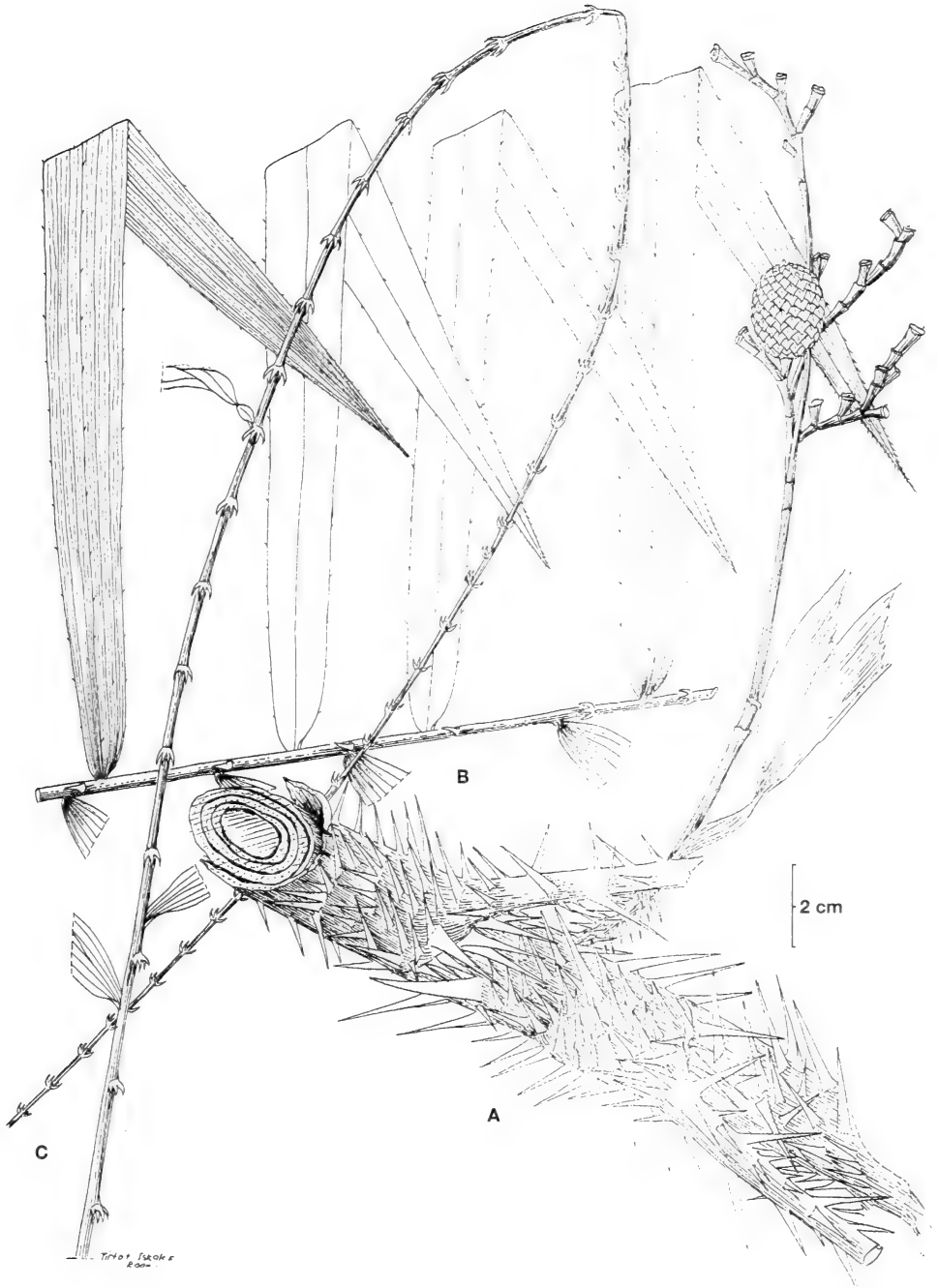


Figure 3. *Daemonorops acehensis* Rustiami.

A. Leaf sheath with infructescence, B. Part of leaves, C. Part of cirrus. All from Dransfield & Saerudin 2015.

blackish at the tip, proximally armed with single hook-like spines; leaflets mostly regularly arranged, slightly irregular towards the leaflet tip, 25 on each side of the rachis; leaflets lanceolate, papery, acute, 24–26 cm long, 2 cm wide, armed with scattered, reddish, short bristles along the main nerve on adaxial surface. Inflorescences pendulous to 20 cm long; peduncle to 4 cm long, armed with scattered, single spines; peduncular bracts papery, bearing scattered solitary spines, partial inflorescences 4; each bearing up to 6 rachillae; involucre pendulous, flat, just above the involucrophore, 5 mm long; involucrophore short, papery, 2 mm long. Female and male flowers unknown. Fruits rounded, c. 2.2 x 1.8 cm, covered in 12 vertical rows of scales encrusted in reddish brown dragon's blood. Seed ovoid, c. 18 x 7 mm, surface reticulate.

Distribution: Sumatra - endemic to Birungen, Takengon, North Aceh.

Habitat: Found on steep hill slopes in relatively dry montane forest at 1800 m altitude.

Notes: This species, the only dragon's blood species recorded from Aceh, differs from other members of the group by its small habit, the leaf sheath armed with very dense, long, erect spines and with the cirrus only up to 40 cm long.

Acknowledgements

I should like to thank Dr. John Dransfield, Kew, for critical comments on the material and assisting with the Latin diagnosis. I have also to thank Iskak Syamsoedin and Tirto, who prepared the illustrations.

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***Mangifera odorata* (Anacardiaceae) is a Hybrid**

R. KIEW

Singapore Botanic Gardens,
Singapore 259569

Abstract

Mangifera odorata Griff. (pro sp.) is confirmed as a hybrid between *M. foetida* Lour. x *M. indica* L.

Mangifera odorata

Ding Hou (1978) first suggested that the polymorphous *Mangifera odorata* Griff., a well-known Malesian fruit tree locally known as kuwini in Peninsular Malaysia, was a hybrid possibly between *M. foetida* Lour. and *M. indica* L. Corner (1988) also considered this possible because kuwini is difficult to separate from *M. foetida* in the sterile state. They had both noted that kuwini is only known from villages, whereas *M. foetida* is not only grown in villages but has also been collected wild from the forest. *M. indica* is the commercial cultivated mango. However, Kostermans and Bompard (1993) disputed its hybrid status and considered *M. odorata* a 'good species' that could be distinguished from *M. foetida* on leaf venation. Molecular analysis by Teo *et al.* (2002) using AFLP (amplified fragment length polymorphism) produced 28 monomorphic bands specific to *M. foetida* of which 20 occurred in kuwini; while *M. indica* had 22 monomorphic species-specific bands of which 16 occurred in kuwini. Kuwini, in contrast, had no species-specific bands but had additively inherited bands from *M. foetida* and *M. indica*. This provides evidence for the hybrid status of kuwini and that its parents are indeed *M. foetida* and *M. indica*.

Further, UPGMA (unweighted pair group method with arithmetic mean) analysis showed that kuwini has closer genetic similarity to *M. foetida* (76% similarity) than to *M. indica* (66 % similarity).

Kuwini therefore cannot be maintained as a distinct species and is here given taxonomic status as a hybrid.

Mangifera odorata Griff. (pro sp.)

= *M. foetida* Lour. x *M. indica* L.

Griffith, Notul. 4 (1854) 417; Ding Hou, Fl. Mal. 1,8 (1978) 437; Kostermans & Bompard, The Mangoes. (1993) 167.

Type: Griffith 1098 Malacca. (holo K, iso P).

Acknowledgements

Advice on nomenclature from J.F. Veldkamp is much appreciated.

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Taxonomic Notes on the Tree Flora of Brunei: 1

P.S. ASHTON

Arnold Arboretum, Harvard University, U.S.A.
and
Royal Botanic Gardens, Kew, U.K.

Abstract

As a precursor to *The Field Guide to the Trees of Brunei Darussalam*, the following taxonomic changes and novelties are presented: *Gluta wallichii* (Hook.f.) Ding Hou subsp. *lafrankiei* P.S.Ashton subsp. nov. and *Parishia coriacea* P.S.Ashton, sp. nov. (Anacardiaceae); *Canarium latistipulatum* Ridley subsp. *mitus* P.S.Ashton subsp. nov. and *Dacryodes patentinervia* (Leenh.) P.S.Ashton, stat. nov. (Burseraceae); *Hopea rugifolia* P.S.Ashton, sp. nov. and *Vatica patentinervia* P.S.Ashton sp. nov. (Dipterocarpaceae).

Introduction

Brunei Darussalam has become the most intensively collected region, for its area, of Borneo. The tree flora is particularly well collected. Some 7,600 tree collections are cited in Kirkup (1996). This checklist, however, omitted some 300 old collections in the herbaria of the Sarawak Forest Department (SAR) and Forest Research Institute Malaysia (KEP), as well as most of the c. 3,000 ecological voucher specimens collected during the course of the Universiti Brunei Darussalam (UBD)-Royal Geographical Society (RGS) Rainforest Project 1991–1992; by Japanese scientists associated with the Brunei Forest Department's Sungei Liang Research Station supported by the Japan International Collaboration Agency (JICA); by S.J. Davies in the course of establishing permanent plots on behalf of UBD during 1994–1995, and by myself during ecological research on behalf of the Brunei Forest Department during 1958–1959. With these and recent Forest Department collections included, Brunei has achieved a collecting intensity, for trees alone, of almost 30 numbers per 100 km².

Brunei is estimated to have a tree flora of almost 3,000 species, roughly equal to the whole of Peninsular Malaysia and Singapore. Brunei is not a formal participant in the Tree Flora of Sabah and Sarawak project (Soepadmo, 1995), but the occurrence of species in Brunei is noted in that Flora. Initiated in 2001, a ten-year project sponsored by the Brunei Shell Petroleum Company, Universiti Brunei Darussalam, and the Brunei Forest Department under the leadership of Dr Kamariah Abu Salim aims to complete a comprehensive field guide to the tree flora of Brunei based on

the format of the Audubon Guides to U.S. Wildlife and the Collins Guides in Europe. This project is planned to move in tandem with and to complement the Tree Flora of Sabah and Sarawak project. All species recorded from Brunei, and those expected owing to their presence in adjacent regions, will be included in field keys and provided with short field diagnostic descriptions and line illustrations. About one third of the 1,100 species recorded in the 52 ha tree demography plot in nearby Lambir National Park, Miri, Sarawak, for instance, have yet to be found in Brunei, and these will be included, either as descriptions or in footnotes to recorded species.

This enterprise provides an opportunity to observe and collate more detailed information on the natural history of individual species than is possible in floras of larger, less intensively collected regions such as Sabah and Sarawak. It is, therefore, providing opportunity for identification of discontinuities in variation within currently recognised species, meriting specific or infraspecific recognition. In a few cases, novel species are being discovered. This communication will be the first in a series, in which these new entities and taxonomic changes, will be discussed and formalised prior to publication of the volumes of the guide. Mark Coode is thanked for assisting with the Latin.

New Taxa and Status Changes

Anacardiaceae

1. *Gluta wallichii* (Hook. f.) Ding Hou subsp. *lafrankiei* P.S.Ashton, *subsp.nov.*

A *Gluta wallichii* subspecies typica petiolo et foliorum nervis subtus badio-puberulentibus lamina subtiliter coriacea margine tenui revoluta basi cuneata costis utrinsecus 13—18 satis distincta. **Typus:** *Awang Yakup S 8903* Borneo, Sarawak, Semengoh Forest Reserve (holo K, flowers).

Notes: J.V. LaFrankie, in the course of identifying the trees of the 52-ha tree demographic plot within Lambir National Park recognised two distinct entities within the range of variation in *Gluta wallichii* described by Kochummen (1996). In one entity, conforming to the typical subspecies, the bark is pale brown, shallowly cracked and flaking, the leaf glabrescent, the lamina thinly coriaceous, wavy on drying, with shortly tapering base, hardly revolute at the margin (visible by lens only), and with at least 19 pairs of secondary veins. In the other, the bark is red-brown and fissured, the leaf venation beneath and petiole brownish puberulent, the lamina

coriaceous, drying flat, with straight visibly revolute margin, strictly cuneate base and 13–18 secondary pairs of veins. Further, the typical subspecies mostly occurred on clay and sandy clay soils, while the new subspecies occurred on humic yellow sands, and we have found this to be the case in Brunei and elsewhere in the region. Nevertheless, the distinctly narrowed leaves with glaucous undersurface and slender petioles, as well as flower and fruit characters of *G. wallichii* are shared by both entities, so I chose to recognise them as subspecies until more is known about patterns of variation throughout the range of *G. wallichii*.

Other specimens examined: BRUNEI - Bukit Patoi Wood *et al.* SAN 17147 (BRUN, fruit). SARAWAK - Bidi, Bau Burley & Lee 330 (A, K, SAR), Semengoh Forest Reserve Asah Unyong Tree No.156 (K, SAR, young flowers), Rosli S 15774 (K, SAR, young fruit), Rosli S 15746 (K, SAR, fruit), Anderson S 14932 (K, SAR, flowers), S 9387 (K, SAR, flowers).

2. *Parishia coriacea* P.S.Ashton, *sp. nov.*

Parishiae maingayi Hook. *f.* affinis, sed sepalis in fructu brevioribus, foliolis utrinsecus 3 costis lateralibus prominentibus distinguitur. **Typus:** *Niga Ningkat NN 230*, Borneo, Brunei, Bukit Besong, Ukong, (holo, K iso BRUN fruit).

Tree to 30 m tall, 80 cm diam.; bark pale grey-brown, shallowly powdery flaking. Young parts shortly rust-brown hairy, the hairs caducous except on panicle, calyx and nut. Twigs stout c. 1 cm diam., rugose. Leaf rachis up to 40 cm long, petiole up to 18 cm long; leaflets c. 3 pairs, opposite, lamina elliptic, 7.5–20 x 4.5–7 cm, coriaceous, drying grey-brown; base obtuse or cuneate, margin slightly revolute, apex acuminate, acumen to 1 cm long; midrib prominent beneath, narrowly elevated and furrowed above; secondary veins 12–25 pairs with many shorter intermediate veins, slender but prominent beneath, evident but hardly elevated above; the reticulate tertiary veins likewise; petiolules 5–10 mm long, stout. Panicle up to 60 cm long, terminal. Flower bud up to 6 mm diam. Male flower: perianth 4-merous, sepals pubescent, c.1 mm long, petals glabrous, c.2 mm long, stamens 4, surrounding the densely pubescent ovary vestige. Female flower unknown. Fruit: sepals to 5.5 x 1 cm, lorate; nut ovoid, up to 2 x 1 cm, shortly beaked, dark chestnut-brown velutinate.

Distribution and habitat: Endemic to mixed dipterocarp forests on deep yellow coastal sands of the Neogene coastal hills of Brunei and north-east Sarawak, a habitat of exceptional richness and endemism.

Notes: This species is easily distinguished by its relatively short fruit sepals,

at first shorter than the ripening nut, and by its 3 pairs of coriaceous leaflets drying distinctly pale grey-brown, with slender but prominent venation beneath.

Other specimens examined: BRUNEI - Andulau Forest Reserve Ashton BRUN 3272 (BRUN, K fruit), BRUN 18568 (BRUN sterile), Sungei Liang Dransfield JD 7022 (BRUN, K fruit), Bukit Teraja Coode 6959 (BRUN, K fruit), Loagan Merimbun Suzuki K13400 (BRUN sterile). SARAWAK - Bintulu, Labang Forest Reserve Ilias Pa'ie S 15817 (K, L fruit), Limbang, Ulu Medamit Wright & Othman Ismawi S 32313 (K flowers).

Burseraceae

1. *Canarium latistipulatum* Ridl. subsp. *mitus* P.S.Ashton, *ssp. nov.*

A *Canario latistipulato* typico arbor grandis tomento persistenten scabrido, foliolis latoribus, fructibus vastis suave esculentibus differt. **Typus:** Coode 7107 Borneo, Brunei, Bukit Bahak, Rambai (holo K, iso BRUN, young fruit).

An elegant columnar prominently buttressed village tree with dark hemispherical crown. Young twigs, leaflets beneath, leaf stalks and inflorescences sparsely shortly tawny scabrous tomentose. Stipules reniform, up to 15 x 10 mm, attached near the base of the petiole, tardily caducous. Leaflets usually 7, lamina broadly elliptic, c. 11 x 5 cm, applanate, drying dark reddish to greenish brown; base broadly cuneate to obtuse, margin shallowly dentate, apex acuminate, acumen prominent; secondary veins 7-10 pairs, arched, somewhat anastomosing within margin, without intermediate veins, prominent beneath, not so to shallowly depressed above as also the subscalariform tertiary veins. Flowers unknown. Infructescence paniculate. Fruit drupaceous, broadly ellipsoid, up to 8 x 6 cm, lustrous, ripening yellow-brown; mesocarp orange-brown, fleshy and fibrous, resinous; endocarp woody, sharply triangular in cross section.

Notes: It is surprising that this fruit tree, known to Kedayan and Dusun farmers as *mitus*, should have so long remained unrecognised. Admittedly, we only have information of its cultivation in northern Brunei from Bandar Seri Begawan westward to the Tutong valley.

In Kirkup (1996, p. 44), this plant had been mistaken for *Canarium littorale* Blume, but the distinct reniform stipules are placed towards the base of the petiole, which is a distinguishing character of *C. latistipulatum* Ridl., and not on the adjacent twig as in *C. littorale*. The fruits, which have yet to be collected for the herbarium, are the size of a mango. They are buried in order to rot off the highly resinous mesocarp, then the seed within its striking triangular woody endocarp is cleaned and marketed.

The fruit of the typical subspecies, which is said to be a native forest tree of Sabah and Sarawak (Kochummen, 1995), is unknown, but the narrow leaflets, powdery puberulent tomentum and apparently small size serve to distinguish it.

Other specimens examined: BRUNEI – Tutong: Pak Engalau, Tasek Merimbun *Bernstein JHB 394* (BRUN, K sterile), Panchang *K.M. Wong s.n.* (BRUN sterile), Kampong Mitus *P.S. Ashton s.n.* (BRUN, K sterile).

2. *Dacryodes patentinervia* (Leenh.) P.S.Ashton, *stat. nov.*

Basynym: *Dacryodes macrocarpa* (King) H.J. Lam var. *patentinervia* Leenh., *Flora Malesiana* 1, 7 (1976) 821; Kochummen, *Tree Flora of Sabah and Sarawak* 1 (1996) 71.

Typus: *Sinclair & Kadim 10492* Borneo, Brunei, Labi Forest Reserve (holo L, iso K, SAN, SAR fruit).

Tree to 35 m tall, 80 cm diam., with narrow buttresses and pale yellow-brown thinly flaky bark. Bud and young shoots puberulent, other parts glabrous. Leaves: rachis up to 23 cm long and 2 mm diam., slender, terete or somewhat angular towards base; leaflets 5–7; lamina narrowly elliptic to lanceolate, 7–14 x 4–7 cm, drying bright coppery brown with the midrib darker beneath, equal to subfalcate, base cuneate, margin slightly revolute, apex acuminate, acumen tapering, slender, c. 1 cm long; midrib slender beneath, applanate above; secondary veins 10–16 pairs, patent, hardly raised below, evident but applanate above as also the many short intermediate veins and densely reticulate tertiary veins; petiolules 12–35 mm long on lateral, up to 6 cm long on terminal leaflets, adaxially flattened at base otherwise terete, prominently swollen at each end. Inflorescence up to 24 cm long, laxly paniculate, shortly branched, glabrous. Male flower: perianth 3-merous, glabrous; sepals united into a basal cup; stamens 6, anther deltoid; ovary vestige columnar, tapering. Female flower unknown. Fruit broadly ellipsoid, up to 5 x 3 cm, asymmetric with eccentric stigma, ripening lustrous apple red.

Distribution and habitat: Endemic to northwest Borneo from the Rejang valley eastwards, where it is among the most abundant Burseraceae in its chosen habitat, in mixed dipterocarp forest on the deep yellow sands of the Neogene coastal hills; it also occurs in upper dipterocarp forest on shale ridges at 650–800 m, and on ultramafic substrates at Bukit Hampuan, Sabah at 1500 m.

Vernacular names: *Dacryodes patentinervia* is known as *sabal* (Brunei, Iban),

sibut (Tutong, Dusun), and *seladah* (Sarawak).

Uses: The fruit is collected from the forest and eaten as a popular laxative.

Notes: This entity has been confused with *Dacryodes expansa* (Ridl.) H.J. Lam - holotype *Haviland 2271* Sarawak, Kuching (K) - and was formally described as a variety of the well-known *D. macrocarpa* (King) H. J. Lam - holotype *King's Collector 7298* Peninsular Malaysia, Perak (K). All three taxa share a distinctive coppery brown tinge to the dry leaf. Leenhouts (1956) considered *D. macrocarpa*, with the present entity as a subspecies, to differ from *D. expansa* in petal shape, filaments united with the disc, and 6—10(—13) of secondary veins as opposed to 10—13 pairs in *D. expansa*. Later, in 1972, he distinguished the two species according to whether the petiole is terete except for the flattened base (*D. expansa*), or prominently flattened at base (*D. macrocarpa*), and only in 1976 did he redefine variation within *D. macrocarpa* adding var. *patentinervia*, and drew up a new description of *D. expansa*.

Dacryodes macrocarpa, sometimes a large tree of the mixed peat swamp forest, is here distinguished by fruits ripening dull green; leaflets unequal, broadly ovate, of often markedly irregular shape, shortly abruptly acuminate; midrib prominent on both surfaces; secondary veins 7—9 pairs; and inflorescence up to 20 cm long, much branched and stout.

Dacryodes expansa, with which the present entity was originally confused by Hasan and Ashton (1962) and Ashton (1964) seems to be known only from the type from west Sarawak. It differs from *D. patentinervia* in having larger, ellipsoid flower buds up to 4 x 3 mm; 3—4 (not 2) pairs of thinly coriaceous leaflets with 10—13 pairs of ascending secondary veins prominent beneath, and remote tertiary veins; and a flattened, sharp edged, adaxial side to the stout petiole, which is up to 4 mm diam. The fruit is unknown.

Other specimens examined: BRUNEI - Bukit Teraja *Dransfield JD 6867* (BRUN, K fruit), *Coode 6892*(K fruit); Andulau Forest Reserve *Ashton BRUN 253* (BRUN, K fruit), *BRUN 15671* (BRUN sterile), *BRUN 15272* (BRUN sterile), *BRUN 16193* (BRUN fruit), *Wyatt-Smith KEP 80093* (K fruit), *Wood et al. SAN 17487* (BRUN fruit), *ecological specimen Ashton PS 3966* (BRUN sterile), (K); Bukit Kukub *BRUN 16781* (BRUN fruit); Sukang *BRUN 18665* (BRUN fruit); Luagan Lalak, Labi *Niga Ningkat NN 185* (K fruit); Merangking-Buau, Belait *BRUN 16220* (BRUN fruit), Bukit Batu Patam, Ulu Ingei, Belait *Wong WKM 1038* (BRUN, K flowers); Bukit Biang *Wood et al. SAN 17123* (BRUN fruit); Bukit Belalong west ridge *Wong WKM 1534* (BRUN, K fruit); Bukit Belalong south ridge

Wong WKM 1356 (BRUN, K young fruit). SARAWAK - Miri, Lambir National Park: *Dan Hj. Bakar S 4370* (K fruit); *George S 40503* (K fruit), Sungai Jangkang, Bakam Abang Mohtar *S 47111* (K fruit), path to Bukit Lambir *Yeo & Jugah Kudi S 38496* (K young fruit), Mount Lambir *Ilias Pa'ie S 16602* (K young fruit); Gunong Mulu National Park (Camp 3) *S 58412* (K young fruit); *Jugah Kudi S 23696* (K fruit), Bukit Iju, Balingian *Sibat Luang S 23655* (K fruit); Ulu Kenyana, Mukah *Ashton S 19494* (K young fruit).

Dipterocarpaceae

1. *Hopea rugifolia* P.S. Ashton, *sp. nov.*

Hopea mesuoides Ashton, *H. sphaerocarpaceae* (Heim) Ashton, *H. subalatae* Sym. affinis sed lamina coriacea rugulose grisea nervis subtus magis prominentibus basi cuneata, petiolo brevi satis distincta. **Typus:** Wong WKM 1414 Borneo, Brunei, Bukit Belalong south ridge, flowers (holo K, iso BRUN, flowers).

Small monopodial understorey tree up to 20 m tall, 20 cm diam., with low buttresses and stilt roots; bark smooth. Young parts densely evenly minutely grey-brown hairy, the hairs persisting sparsely on leaf venation beneath, midrib above at base, and on petiole. Stipules acicular, up to 6 mm long, caducous. Lamina broadly lanceolate, 5–9 x 2–3.5 cm, chartaceous, drying grey-brown and wrinkling; base broadly wedge-shaped to obtuse, apex acuminate, acumen slender, prominent up to 1.5 cm long; midrib slender but elevated beneath, obscure and depressed above; secondary veins c. 10 pairs, slender but distinctly raised beneath, with short intermediate veins; tertiary veins densely scalariform, evident beneath; petiole to 4 mm long, slender. Panicle axillary, up to 4 cm long, slender, when dried up to 0.7 mm diam. at base, terete, glabrous, singly branched; bracteoles deltoid, up to 1 mm long, glabrous, subsistent. Flower bud to 1.5 mm diam. at anthesis, small, broadly ovoid; calyx sparsely pubescent outside, sepals suborbicular, to 1 x 1 mm diam., outer two subacute or obtuse, inner three mucronate; corolla purple, petals oblong, obtuse, to 3 mm long, puberulent on parts exposed in bud; stamens 15, filaments short, broad at base, tapering, anthers ellipsoid, connectival appendage c. twice length of anther, slender; ovary and stylopodium short, narrowly cylindrical, truncate, medially constricted, glabrous, style conical, short, glabrous. Fruit glabrous; pedicel up to 5 mm long, 0.5 mm diam., very slender; sepals ovate, subequal, up to 8 x 7 mm when ripe, acute, saccate, incrassate and appressed to nut; nut up to 10 x 8 mm, broadly ovoid, with up to 2 mm-long prominent stylopodium remnant.

Distribution and habitat: It occurs, like many dipterocarps with wingless fruits, in dense clusters in the forest understorey, on sandy clay soils at low altitude and also skeletal humic clay soils in upper dipterocarp forest at 600–800 m altitude. At Lambir National Park, north-east Sarawak, it shares the forest with *Hopea mesuoides* P.S.Ashton, which is, however, confined there to yellow humic sandy soils.

Notes: *Hopea rugifolia* is named for its distinctively wrinkled fallen leaf in a family where leaves are generally more coriaceous. This species belongs to a group of closely similar monopodial understorey species comprising *H. mesuoides* (Sarawak north-east of S. Balingian and Brunei), *H. sphaerocarpa* (Heim) P.S.Ashton (with which *H. rugifolia* has heretofore been confused but which is now confirmed only from Sarawak west of Batang Lupar), and *H. subalata* Symington. The last is a point endemic of Kanching Forest Reserve, Selangor, where it is locally gregarious on the Klang Gates quartzite in association with the only known west coast locality of *Dryobalanops aromatica* Gaertn. f. *H. subalata* has been shown to be triploid and likely partially apomictic though adventive embryony (Kaur *et al.*, 1978).

The present species is distinguished from these three species by its chartaceous leaf drying grey-brown and wrinkling, with cuneate rather than obtuse base, prominent secondary veins beneath, and short petiole.

Other specimens examined: SARAWAK - Bukit Mersing, Anap Sibat Luang S 25028 (K fruit), Lambir National Park S 46439 (K fruit).

2. *Vatica patentinervia* P.S.Ashton, **sp. nov.**

Vaticae congestae Ashton similis sed costis foliorum lateralibus utrinsecus 7–8 acumine prominenti tomento plano distinguitur, a *V. endertii* Sloot. inflorescentibus ramifloris brevioribus, fructibus maioribus, ramulis tomentosus, lamina coriacea costis paucioribus differt. **Typus:** *Ilias Pa'ie* S 15148 Borneo, Sarawak, Bintulu, Segan Forest Reserve (holo K, iso SAR fruit).

Subcanopy tree, to 30 m tall. Young parts densely evenly buff pubescent, the hairs persistent on twig, petiole and inflorescence. Twig slender, ribbed. Stipule narrowly deltoid, c. 5 x 3 mm. Lamina elliptic-obovate, 7–15 x 3.5–6 cm, thinly coriaceous, appanate to narrowly revolute, drying pale buff-grey; base cuneate to obtuse, apex acuminate, acumen up to 1 cm long, prominent; midrib hardly elevated above, prominent beneath; secondary veins 7–8 (up to 12 in juveniles) pairs, evident above, prominent beneath; tertiary veins reticulate; petiole 1.2–2.5 cm long, rugulose.

Inflorescence axillary to ramiflorous, fascicled, up to 3 cm long, up to 2 mm diam., singly branched. Flowers unknown. Fruit: pedicel up to 4 mm long, slender; sepals unequal, free to base; longer two up to 12 x 2.2 cm, lorate, obtuse, prominently 3-veined; shorter three up to 4.5–1.5 cm, narrowly ovate, acute, recurved. Nut ellipsoid, up to 12 x 8 mm, tapering to 6 mm-long style remnant, glabrous.

Notes: This species, which is only known from clay soil in mixed dipterocarp forest from two localities, shares the large fruit and fascicled ramiflorous inflorescences of *Vatica congesta* P.S.Ashton, but is distinguished by the distinct even buff pubescence of twig, petiole and inflorescence, fewer (7–8) more slender pairs of secondary veins (more in juveniles; 9–11 pairs in *V. congesta*), and prominently acuminate, not obtuse or retuse, less coriaceous lamina. *V. endertii* Slooten differs in having glabrescent young parts, solitary terminal or axillary inflorescences, smaller fruit, and a more coriaceous lamina with 11–13 pairs of secondary veins. Saplings, whose leaves may have up to 12 pairs of secondary veins, can also be confused with those of *V. odorata* (Griff.) Symington subsp. *mindanensis* (Foxw.) P.S.Ashton, but the leaves dry distinct buff-grey, which with the dense even buff pubescence on twigs and petioles serves to distinguish them from all three species.

Other specimens examined: BRUNEI - Kuala Belalong Ashton S 5744 (SAR sterile), Balslev et al. 62, 68, 84, 91, 123, 133, 160, 188, 208, 249, 255, 286, 359, 363, 365, 369, 372, 396, 437 (UBD, sterile ecological specimens).

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New Taxa and Combinations in the Genus *Diplycosia* (Ericaceae) of Borneo and Peninsular Malaysia.

G.C.G. ARGENT

Royal Botanic Garden Edinburgh,
Edinburgh EH3 5LR, U.K.

Abstract

Seven new species of *Diplycosia* and one new form are described: *D. abanii*; *D. mogeana*; *D. rhombica*; *D. mantorii*; *D. othmanii*; *D. paulsmithii*; *D. ngii* and *D. salicifolia* Sleumer forma *gigantea*. The genus *Pernettyopsis* King & Gamble is reduced to synonymy with *Diplycosia* and the relevant new combinations are made. Advice on collecting material of the genus is given.

Introduction

The genus *Diplycosia* Blume was effectively monographed for Flora Malesiana (Sleumer 1966–1967), as all but two of the 97 species then recognised occurred in the Malesian region. Since then there has been little interest in a genus of small epiphytic shrubs with rather insignificant flowers and no known economic value. A few new species have been described (Argent 1982, 1989) and new accounts of the Kinabalu species have been published (Argent in Wong & Phillipps, 1996; Beaman *et al.*, 2001), but there is little there to advance our understanding of the relationships within the genus. Molecular work (Kron, 2001) suggests that the genus is nested within *Gaultheria* although morphologically it remains quite distinct and only very rarely is there any problem in referring even sterile plants to one or other of these genera. The genus is most diverse in Borneo with well over half the total number of described species and Mt Kinabalu remains by far the richest single locality with 27 species known from its environs. In the present paper, one new species from Peninsular Malaysia and six new species and one new form from Borneo are described emphasizing Borneo as the centre of diversity of the genus.

The genus is under-collected partly because of the small flowers but also because many species are epiphytes growing in peaty accumulations on large trees and are thus inaccessible. Even when they are collected the resulting specimens are often poor. Collections made with field descriptions of flowers often lack them in the herbarium as the flowers easily fall off in drying and careless handling. Details of indumentum (of great importance in discriminating taxa) are often difficult to interpret because young stems

(which do not carry flowers) are not collected and old ones lose bristles and hairs or conversely appear to gain them with the erect branches of algal epiphytes. Field descriptions of the fruit may eventually lead to useful subdivisions within the genus but these are rarely adequate and need to be made preferably with field sketches of the fruit structure which, because of its fleshy nature, is lost on pressing and drying. Variations in both wild and cultivated specimens observed have led to the proposal in this paper to reduce the genus *Pernettyopsis* King & Gamble to synonymy with *Diplycosia*. There are undoubtedly many more species to be recognised and described especially from the mountains in Borneo but more, carefully prepared collections are needed. Specimens should preferably possess open flowers, some of which should be separated on collection into a numbered packet so that they are less likely to be lost on drying and handling. Next most important is to look carefully for some new young but fully or nearly fully expanded leafy shoots which will show the indumentum structure clearly. If there are mature fruits, a quick sketch showing which parts are fleshy and the relative position and length of calyx lobes to ovary might ultimately prove illuminating. Sterile specimens with the indumentum in good condition are still worth collecting as these can often still be identified to a species.

Diplycosia species are not especially easy to cultivate although we have maintained at least one of our collections in the Royal Botanic Garden Edinburgh for more than 25 years. It would undoubtedly give interesting information as to variability if more species could be grown satisfactorily. Some species are extremely attractive plants with a dense golden-brown indumentum but unfortunately these have proved to be the most difficult to keep alive in cultivation.

New Taxa

1. *Diplycosia abanii* Argent, *sp. nov.*

(Named after the collector of the species from the Forestry Department in Sandakan, Sabah.)

Diplycosiae clementium Sleumer similis sed setis in pedicellis calyceque adpressis, foliis laevibus (haud rugosis) cum reticulo obscuro, venis lateralibus abaxialibus haud elevatis et setis in pagina inferiore foliorum brevioribus magis sparsis et semiadpressis (non patentibus) praecipue differt. **Typus:** Borneo: Sabah, Beluran District, Bukit Monkobo, 15 March 1982, *Aban Gibot* SAN 95227 (holo SAN; iso A *nv*, BO, K *nv*, KEP *nv*, L, SAR *nv*, SING *nv*).

Figure 1

Shrub 1–2 m tall, stems covered in coarse, brown, semi-appressed bristles but with no obvious finer indumentum. Petiole 4–7 x 1–2 mm, with semi-appressed bristles, becoming glabrescent with age. Leaf blade ovate to broadly elliptic, 6–10 x 2.5–4.5 cm, glabrescent above, sparsely setose below with variable length setae which are more or less appressed, these breaking off to leave a black punctate surface where old and abraded, not especially setose on the midrib; coriaceous, base rounded; margin entire, slightly revolute at first fringed with rather fine semi-erect bristles; apex shortly acuminate, usually with a fine acute point but occasionally rounded, the terminal gland small and not especially conspicuous, midrib impressed above, distinctly prominent beneath, lateral veins plane or minutely impressed above, plane beneath, pinnate, 3–7 per side, spreading at *c.* 45 degrees and then arching round to link with the one above and thus creating a rather indistinct, looping intramarginal vein. Flowers fasciculate or solitary, 1–2 per axil; pedicels at anthesis 10–12 mm long and less than 1 mm thick, densely covered with appressed bristles that are up to 2.5 mm long. Bracteoles *c.* 1 mm long, almost semi-circular, the backs and edges with long semi-appressed to appressed bristles. Calyx *c.* 4 mm long with erect, appressed bristles, tube *c.* 1.5 mm long, lobes *c.* 2.5 mm long. Corolla *c.* 5.5 mm long with a slightly verrucose surface and some crimped hairs outside, glabrous inside, lobes 3.5 mm long, triangular with broadly acute points. Stamens *c.* 4 mm long, filaments sigmoid, glabrous, *c.* 2 mm long; anthers *c.* 2.75 mm long, echinulate. Disc glabrous; ovary glabrous, style *c.* 3.5 mm long, cylindrical, glabrous. Fruit not seen.

Notes: This distinctive species keys out in Sleumer (1966–67) with the larger leaved, coarsely hairy species. The type specimen does not have any young shoots and so it is not absolutely certain that there is not a fine puberulous indumentum in the young state but none of the stems examined show any evidence of this. In any case this specimen does not agree with any of the species that have this character. *Diplycosia abanii* appears most closely related to *D. clementium* Sleumer, a common species on Mt. Kinabalu and also recorded from N Sarawak. Both have the slender pedicels, hairy corolla and a similar general venation pattern, but *D. abanii* differs in its longer patent bristles on all conspicuous parts, rugose leaves with much more pronounced venation, the main lateral veins on the underside of the leaves being strongly raised. *D. aurea* Sleumer has appressed bristles but these are much denser on the undersides of the leaves and the pedicels are quite different, being much thicker, 1.5–2 mm wide and the bracteoles are larger and more densely hairy. Bukit Monkobo

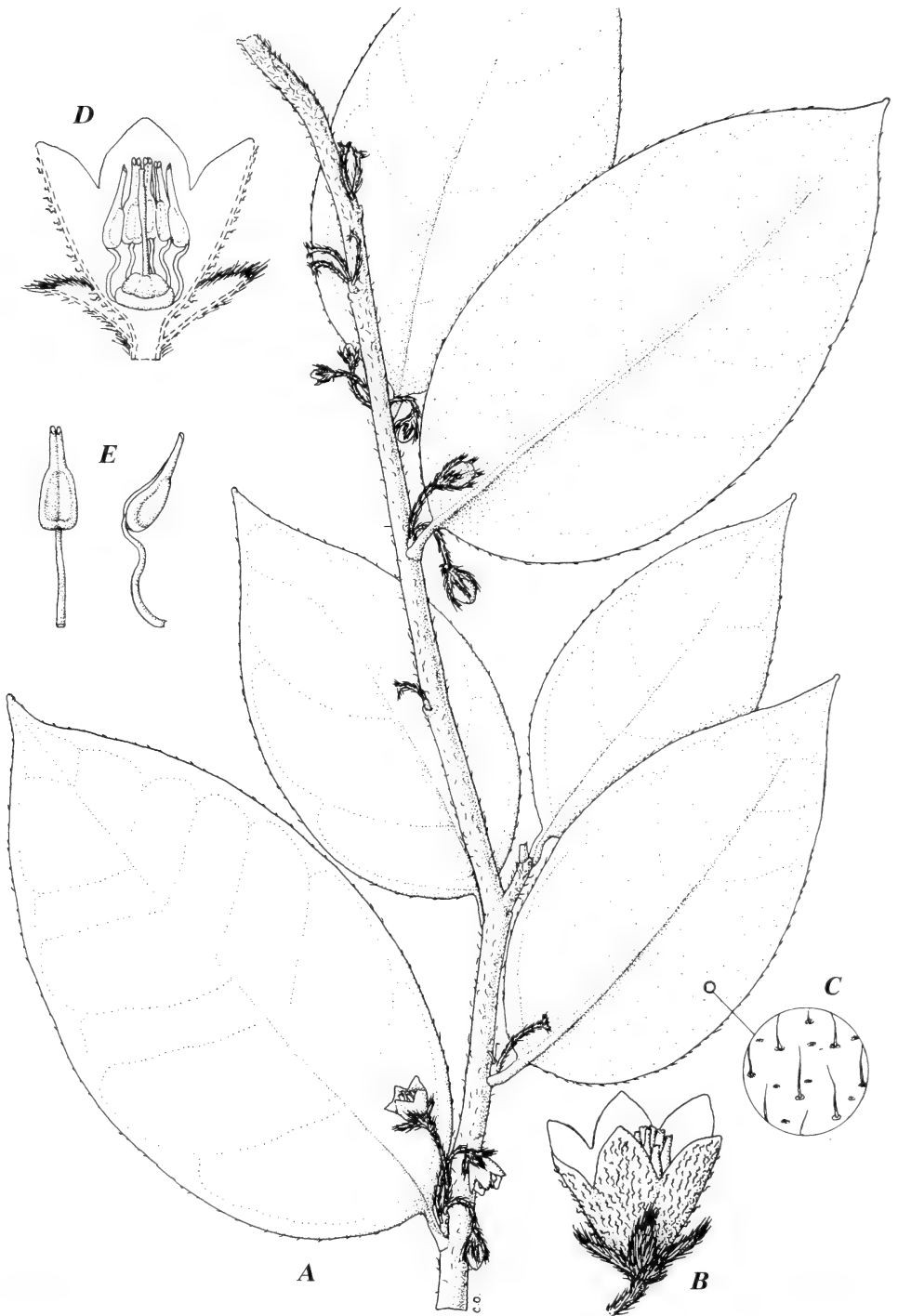


Figure 1. *Diplycosia abanii*. All from Aban 95227: **A.** habit x 1; **B.** flower x 3; **C.** abaxial leaf surface x 25; **D.** half flower x 3; **E.** stamens x 5.

is an isolated peak away from the main mountain ranges that might well be expected to have other endemic species. The fruits are described as hairy and brownish on the label but this undoubtedly refers to the bristly calyx which becomes fleshy and forms the 'false fruit'; the ovary itself is glabrous. The collection is described as coming from "hill top mossy forest" and is probably restricted to the small area of this type of forest about the summit of Bukit Monkobo where it is probably an epiphyte.

2. *Diplycosia mogeana* Argent, *sp. nov.*

(Named in honour of the collector of the type material, Dr Joannis Mogeia, formerly curator of Herbarium Bogoriense).

Diplycosiae clementium Sleumer et *D. abanii* Argent (supra) affinis sed ab ambabus foliorum basibus cuneatis, calyce sine setis et corolla glabra differt. **Typus:** Borneo: Central Kalimantan, Bukit Raya and upper Katingan (Mendayai) River area c. 10 km. NNW of Tumbang Tosah at camp 2, c. 112° 50'E 0° 30'S, 1st Dec. 1982, *Mogeia 3814* (holo BO; iso L).

Figure 2

Semi-epiphytic shrub c. 1 m tall, stems at first covered in coarse, brown, patent bristles but with no finer indumentum. Petiole 6–8 x c. 2 mm, with irregularly patent bristles which often persist for some time. Leaf blade elliptic, 6–11.3 x 2.5v3.5 cm, glabrescent above leaving the surface obscurely punctate, sparsely setose below on the veins, the surface distinctly punctate with hair bases and a few much larger black gland-like structures; coriaceous, base cuneate; margin entire but with rather persistent setae along the edge, flat or very slightly revolute, apex narrowly acute or slightly acuminate, with a fine acute point, the terminal gland small and not especially conspicuous, midrib very slightly impressed above and distinctly prominent beneath, lateral veins plane above, distinctly prominent beneath, venation pinnate with 3–7 lateral veins per side, spreading at c. 45° in the basal half but much more widely in the upper part, each arching round to link with the one above. Flowers fasciculate or solitary, up to 3 per axil; pedicels 2–6 mm at anthesis, c. 1 mm thick and apparently increasing in thickness in fruit, densely covered with semi-erect bristles that are often curved. Bracteoles c. 1 mm diam., almost semi-circular, the backs with a few bristles at the base and the edges glandular fimbriate. Calyx c. 4 mm, tube c. 1.5 mm long, the lobes triangular, c. 2.5 mm long, glandular fimbriate along the edges otherwise glabrous. Corolla c. 6 x 5 mm, glabrous, lobes 2 x 2 mm with rather thick blunt points, glabrous inside, lobes 3.5 mm long, triangular with broadly acute points. Stamens c. 4 mm long, filaments sigmoid, glabrous, c. 2 mm long; anthers c. 2.75 mm long, echinulate. Disc

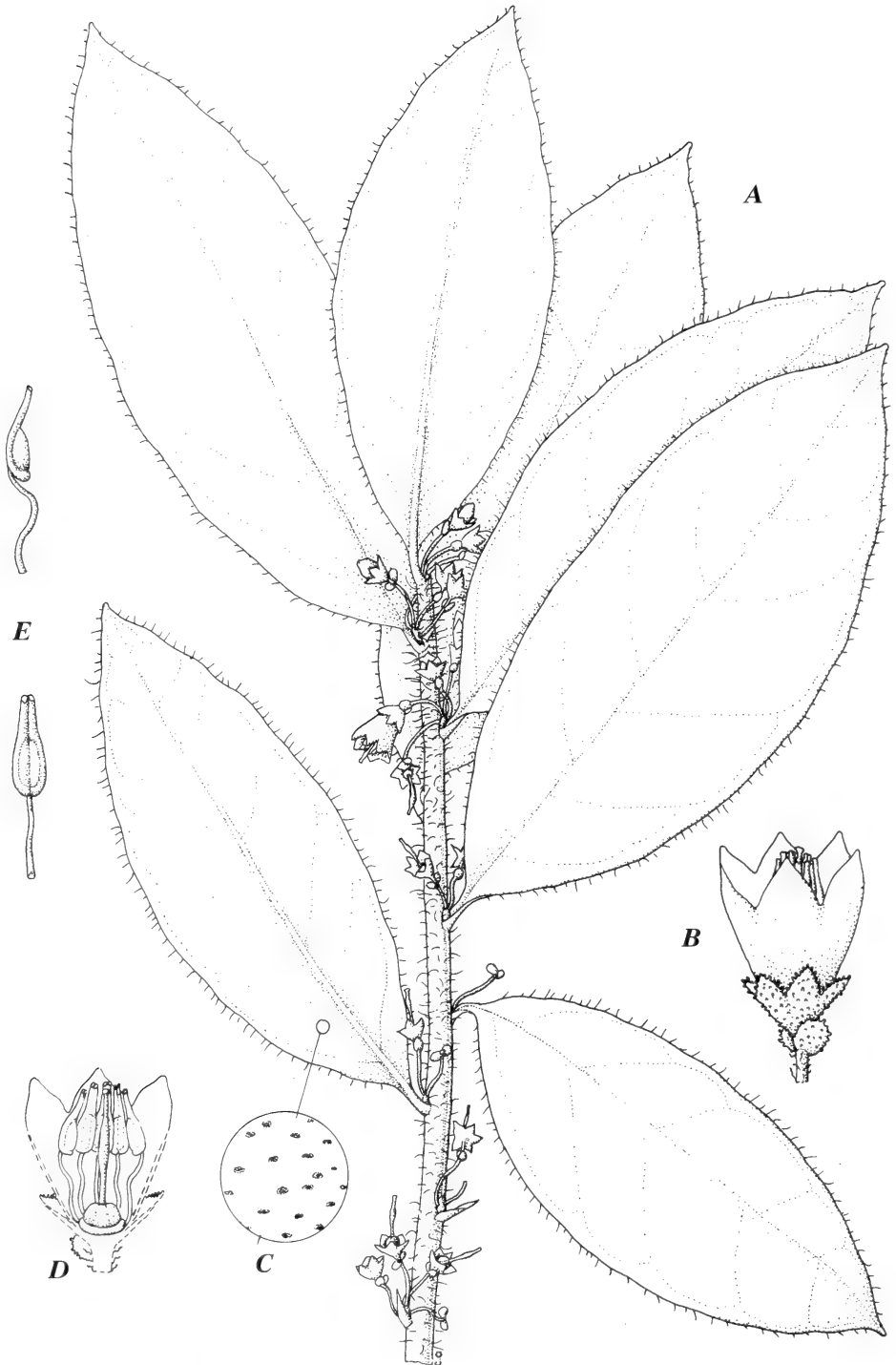


Figure 2. *Diplycosia mogeana* All from *Nooteboom* 4586: **A.** habit x 1; **B.** flower x 3; **C.** abaxial leaf surface x 25; **D.** half flower x 3; **E.** stamens x 3.

glabrous; ovary glabrous, style c. 4.5 mm, swollen about the middle, glabrous. Fruit not seen.

Notes: This species keys out in Sleumer (1966–67) to couplet 24 but the characters do not fit either species remaining beyond this lead: *Diplycosia rufescens* Schltr. from Papua New Guinea and *D. triangulanthera* J.J.Sm. from Sulawesi are unlikely allies purely from a geographical point of view as very few *Diplycosia* species occur on more than one island. Both of these species have much smaller leaves and flowers than *D. mogeana*. Of the Bornean species, it is most similar to *D. clementium* Sleumer and *D. abanii* Argent (described above) but it differs from both in having cuneate leaf bases and lacking bristles on the calyx and hairs on the corolla. The type is described as a semi-epiphytic shrub growing in primary mossy rain forest at 1600 m, c. 1 m tall with pale greenish flowers and the leaves very pale beneath. The Nooteboom collection, however, is described as a treelet 3 m tall with white flowers growing at 1500 m.

Specimen examined: Borneo, Kalimantan, Bukit Raya, 112° 42'E 0°39'S, 24th Jan 1983, Nooteboom 4586 (L),

3. *Diplycosia rhombica* Argent, *sp. nov.*

(Named from the distinctive narrowly rhomboidal shape of the leaves).

Diplycosiae microsalicifoliae Argent similis sed ambitu folii rhomboideo et pedicellis multo (plus quam triplo) longioribus, petiolis cum indumenti vestigiis praeditis recedit.

Typus: Borneo, Sabah, Lahad Datu District, on the ridge top of Mt Tribulation, 4° 51'N 117° 39'E, 16th Aug 1976, Cockburn SAN 84884 (holo K; iso BO *nv*, KEP *nv*, L *nv*, SAR *nv*, SING *nv*).

Figure 3A

Small shrub to c. 60 cm tall. Branches densely leafy, grooved and angled when dry, glabrous or with traces of a very fine, minute, whitish pubescence. Petiole 2–4 x c. 1 mm, weakly grooved above, sometimes slightly verruculose and with few small simple white hairs. Leaf blade narrowly rhomboid or narrowly elliptic, (25–)35–53 x (5–)8–13 mm, somewhat coriaceous; base narrowly attenuate; margin entire, flat and smooth or sometimes slightly undulate; apex acute with a prominent apical gland which often forms a mucronate tip, glabrous and smooth above, punctate with black glands below but otherwise hairless; veins ± obsolete except for the slender midrib which is not raised above and only minutely so beneath. Flowers solitary

or in pairs from the leafy axils. Pedicels, glabrous, up to 16 x 0.3 mm. Bracteoles broadly ovate, *c.* 8 mm long, fimbriate, with glands along the margins. Calyx *c.* 2.3 mm long, lobes 0.8 mm long, deltoid, fimbriate, with glands along the margins, and occasionally on the abaxial surface, otherwise glabrous, lacking a conspicuous terminal gland but with a subapical swelling on the abaxial side of each lobe. Corolla (submature) to *c.* 2 mm long, pink, subglobose, glabrous, lobes *c.* 0.3 mm. Filaments linear, flattened, glabrous, *c.* 1 mm long; anther cells *c.* 0.8 mm long, finely granular echinulate, tubules narrow, *c.* 0.3 mm long. Disc glabrous; ovary glabrous *c.* 1 mm long, style, *c.* 1mm, glabrous, slightly swollen near the middle. Fruit not seen.

Notes: This very distinct species unfortunately lacks fully open flowers and there are no young branches to unequivocally display the indumentum. Most branches examined are completely glabrous, but there are traces of a fine white indumentum in a few places on the stems and several of the petioles have traces of a simple, short white indumentum, which is usual only in species which have hairy stems when young. Superficially *Diplycosia rhombica* looks similar to some forms of *D. microsalicifolia* Argent (1982) but the very long filiform pedicels more than 10 mm long are quite different to the short, 3–5 mm pedicels of *D. microsalicifolia*. It keys out in Sleumer (1966–1967) on the basis of the stem having a fine white puberulence to *D. kemulensis* J.J.Sm. but that species has much larger triplinerved leaves and short pedicels only 4 mm long and is described as having 4-merous flowers. If keyed as if the branches are completely glabrous, *D. rhombica* agrees with neither alternative at couplet 103 as the pedicels are completely glabrous and it is quite different from the three Bornean species beyond this point in the key, *D. urceolata* Stapf, *D. commutata* Sleumer and *D. heterophylla* Blume var. *latifolia* (Blume) Sleumer, as in these species all three have prominent lateral veins in the leaves, which this new species does not. Mt Tribulation, from which *D. rhombica* comes, is an isolated ultramafic mountain both features commonly associated with endemism and it is not surprising to find this novelty growing near the summit at *c.* 800 m (2,600 ft.). It is reminiscent of *D. sphenophylla* Sleumer on Kinabalu that also appears to be restricted or at least most common in ultramafic areas.

4. *Diplycosia mantorii* Argent, *sp. nov.*
(Named after the collector, Asik Mantor).

Caulibus pubescentia humili rigida brevi patenti tantum instructis, foliis usque ad 26 x 12 mm venis lateralibus fere perfecte obscuris, pilis longis

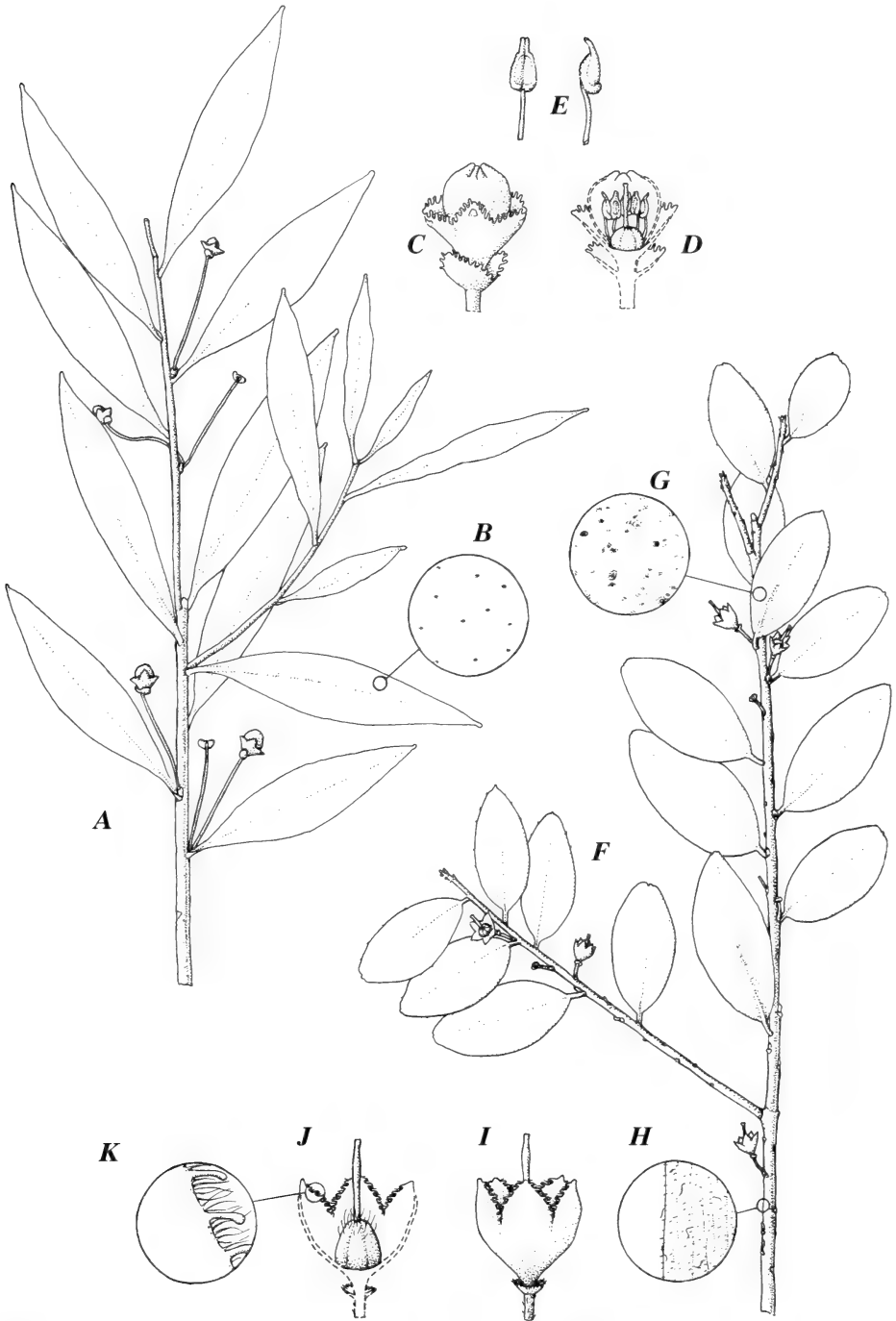


Figure 3. *Diplycosia rhombica* All from Cockburn SAN 84884: **A.** habit x 0.8; **B.** abaxial leaf surface x 25; **C.** flower x 3; **D.** half-flower x 3; **E.** stamens x 5. *Diplycosia mantorii* Type: **F.** habit x 1; **G.** abaxial leaf surface x 25; **H.** stem surface x 25; **I.** flower lacking stamens and corolla x 3; **J.** partial l.s. section to show ovary and style x 3; **K.** margin of calyx lobe x 25.

ovarii e parte superiore exorientibus insignis.

Typus: Borneo, Sabah, Penampang District, Tunggol FH. Km 45, Jln. K. Kinabalu, c. 6° 14'N. 116° 25'E 17th July 1986, *Asik Mantor SAN 113779* (holo K; iso KEP, SAN).

Figure 3B

Climber to 4 m tall. Branches laxly leafy. Stems covered in a very short (c. 0.02 mm long) rigid, patent, pubescence together with a few much longer caducous, glandular hairs on the youngest stems. Petiole 1.5–2 x c. 1 mm, weakly grooved above, with the same short pubescence as the stems. Leaf blade elliptic, 13–26 x 5–12 mm, glabrous above with a distinctly finely undulate surface when dry, somewhat irregularly punctulate below, puncta probably representing gland bases, coriaceous; base broadly cuneate; margin more or less entire when mature and very slightly revolute but finely denticulate when young with glandular hairs in the angles, these sometimes leaving minute puncta after being shed; apex rounded, sometimes mucronate and/or retuse, the terminal gland occasionally conspicuous but mostly obscure; midrib slightly depressed but mostly rather obscure above, slightly raised and much more distinct below, lateral veins almost entirely obscure, occasionally 1–2 traces from near the base arching upwards. Flowers solitary, mostly from upper leaf axils; pedicels short and slender, 2–3 x 0.5 mm, covered with fastigiate glandular hairs. Bracteoles small, c. 0.5 mm wide, ± semi-circular and fimbriate round the edges. Calyx c. 4 mm long, tube c. 2 mm long, glabrous, lobes c. 2 mm long, triangular with broadly acute points, densely hairy and glandular along the margins otherwise glabrous, without any distinctively large gland at the apex. Corolla and stamens not seen. Disc glabrous; ovary with long but rather sparse erect hairs on the upper half, style c. 2.5 mm long, with a few appressed hairs near the base, otherwise glabrous. Fruit not seen.

Notes: If the anthers were known this species might key out in Sleumer (1967) to *D. consobrina* Becc., which is recorded from low altitude on Gunung Serapi (Mt. Mattang) in Sarawak, but that species has bristles on the stems and has distinctly 3- or 5-veined leaves. Ignoring stamen morphology, it keys out with some difficulty in both Sleumer (1967) and Argent (1989) to *D. kemulensis* J.J.Sm. but that species is from much higher altitudes and has larger triplinerved leaves and a glabrous ovary. This very distinctive new species looks superficially like *D. elliptica* Ridl. but is totally lacking in the long bristles that clothe the stem in that species, it also lacks the stipule-like axillary perulae that are usually distinctive in *D. elliptica*, and *D. mantorii* has dense glandular hairs on the pedicels

compared with the almost glabrous pedicels of *D. elliptica*. *D. mantorii* is from one of the low hills rising from the coastal plain between Kota Kinabalu and Kota Belud and although described as a climber, it is almost certainly an epiphyte probably rooting along its stems into moss or peaty accumulations as opportunities occur. More material with good flowers is needed to complete the description but *D. mantorii* is unlikely to be confused with any other *Diplycosia* species.

Another collection *Argent 25108518*, also from Sabah, but from much further south at Long Pa Sia, Sipitang District, agrees very closely with the above specimen differing only in the larger leaves up to 3 cm long. It is also incomplete, having only old pedicels with the bracteoles still attached although the field note states "fruits grey-blue with short pedicels".

5. *Diplycosia salicifolia* Sleumer forma *gigantea* Argent, *forma nov.*

A forma *salicifolia* foliis multo latioribus (usque ad 5 cm latis versus 2 cm latis) et caulibus novellissimis minute pubescentibus differt.

Typus: Malaysia, Sabah, Long Pa Sia, Sipitang District, c. 4° 26'N 115° 44'E. 25th Oct. 1985 *Argent & Lamb 2510859* (holo SAN; iso A *nv*, E, L).

Notes: The type specimen was growing with vigorous hanging stems to 3 m long in submontane forest as an epiphyte on a tree just above the flood zone of a river at c. 1100 m altitude. It is without flowers but has pedicels and bracteoles in good condition. In all observable respects it agrees with *Diplycosia salicifolia* except in the very much larger leaves up to 5 cm wide (up to 2 cm in the type form) and the puberulous stems (glabrous in forma *salicifolia*). The vigorous stems and broader leaves might be accounted for by the lower altitude and different habitat from that of the type form, which was from a ridge on Gunung Mulu between 2010–2200 m. However, another collection from the Long Pa Sia area in the Sandakan herbarium, *Lamb & Dolois 69*, from a similar altitude to this new form, is much more similar to the typical form. These collections represent new records of *D. salicifolia* from Sabah and reinforce the relationship of the flora of the Long Pa Sia region with that of the G. Mulu and G. Murud complex in northern Sarawak.

6. *Diplycosia othmanii* Argent, *sp. nov.*

(Named after the senior collector of the type specimen, Hj. Othman of the Sarawak Forest Department).

Foliis majusculis ad apicem caudatis venis arcuatis supra basem exorientibus, pedicellis brevissimis et antheris sagittatis brachiis basalibus longis distincta.

Typus: Borneo, Sarawak, Ulu Sg. Mengiong, Balleh, Kapit District, 19 Oct 1988, *Othman & Rantai Jawa S55787* (holo SAR; iso E, K, KEP nv., L).

Figure 4

Epiphytic shrub. Branches laxly leafy, covered in long gland-tipped bristles and with a short, white, patent indumentum. Petiole 3–4 x *c.* 1 mm, with both long glandular hairs and short, white, patent bristles. Leaf blade broadly elliptic to ovate, 4.5–5.3 x 2.1–3.3 cm, glabrescent above, laxly covered with rufous bristles, with dark bases beneath; leathery, base rounded or broadly tapering, shortly contracted into the petiole, margin flat, minutely crenulate and at first fringed with bristles, apex mucronate to shortly caudate, the terminal gland small, major lateral veins 2–3 on each side, curved ascending, mostly arising above the blade base, narrowly impressed above, very slightly raised beneath. Flowers axillary, solitary or in pairs. Pedicels very short *c.* 1.5 mm long. Bracteoles almost sessile, semicircular, *c.* 1 mm wide, glabrous except for the shortly white ciliate margin. Calyx up to *c.* 2.7 mm long, glabrous outside, lobes deltoid, *c.* 1 mm long, fringed with very short, white hairs, without any trace of terminal or marginal glands. Corolla *c.* 4.8 mm long, glabrous. Stamens *c.* 3.8 mm long; the filaments *c.* 2 mm long, flattened, glabrous, expanding just above the base and then tapering upwards; anthers 2.4 mm long, thecae *c.* 1.2 mm long, dark brown, coarsely echinulate and with long basal free ‘arms’ to *c.* 0.5 mm long, tubules smooth, paler brown to *c.* 1.2 mm long, opening with a broad oblique pore which extends to half the tubule length. Disc glabrous; ovary glabrous, subspherical, to *c.* 1.6 mm, style glabrous, *c.* 2.4 mm long. Fruit not known.

Notes: Similar to *Diplycosia pilosa* Blume from West Java at least in some key characteristics, but *D. othmanii* has very different leaf venation with its weakly raised pinnate lateral veins compared to the very distinct strongly abaxially raised and arching lateral veins of *D. pilosa*, *D. othmanii* also lacks the distinct revolute edge of *D. pilosa*. The most distinctive features of *D. othmanii* are the very short pedicels, the caudate leaf apices and the long spreading prolongations at the base of the anthers. It keys out in Sleumer (1966–1967) with *D. microphila* Becc. and *D. kostermansii* Sleumer, but it has much larger leaves than either of these species. Alternatively, it would key out in Argent (1989) to *D. memecyloides* Stapf, but that species has no long glandular bristles on the stems. The leaf venation, where the main veins usually arise from well above the base of the blade, is also distinctive.

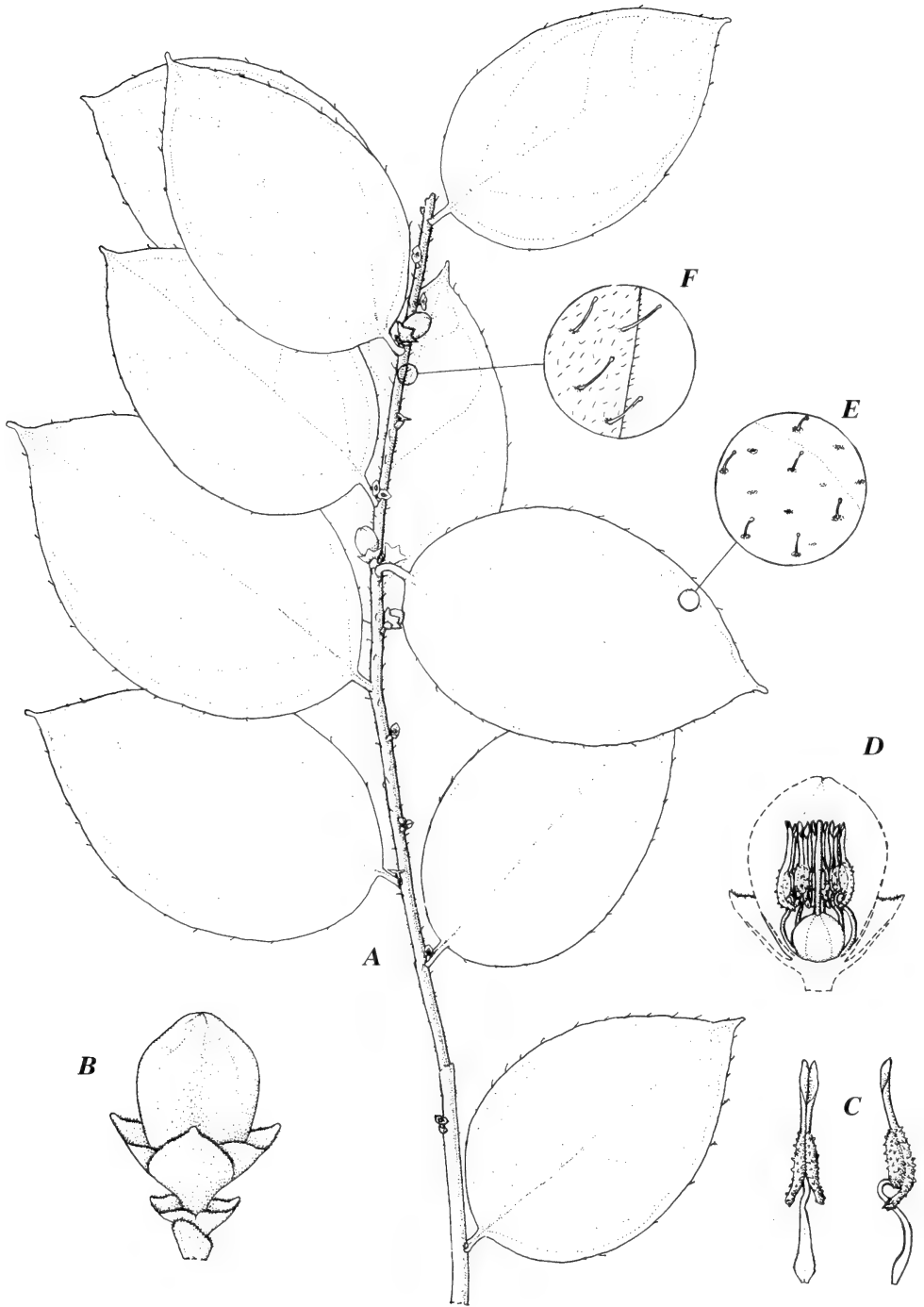


Figure 4. *Diplycosia othmanii* All from *Othman & Jawa S 55787*: **A.** habit x 1.2; **B.** flower bud x 4; **C.** stamens x 6; **D.** half flower bud x 4; **E.** abaxial surface of the leaf x 25; **F.** surface of the stem x 25.

A second collection, *S* 8679, agrees well with the type although it has no flowers. It is slightly more slender than the type with the leaves up to 21 mm wide and with less pronounced caudiform apices and broadly tapering rather than rounded bases. It is possible that the description of green fruits on the label actually applies to the flowers as the specimen has no fruits. The type was described by the collector as an epiphyte at 5 m in mixed dipterocarp forest, it is unclear whether 5 m refers to altitude or the height up the host tree. That it grows in dipterocarp forest suggests that this species is found at low altitudes and the Brunig collection confirms this as it was collected at *c.* 15 m altitude (50 ft) in very wet *kerapah* (swampy heath forest) at the foothill of a terrace in a mossy sheltered position.

Specimen examined: Borneo, Sarawak, Bintulu District, Sungai Penyilam, 17th Feb 1961, *Brunig S* 8679 (SAR).

7. *Diplycosia paulsmithii* Argent. *sp. nov.*

(Named after Paul Smith, plant collector, keen observer and explorer in SE Asia who was one of the collectors of the type specimen).

A Diplycosia aurea Sleumer foliis anguste lanceolatis plus quam triplo longioribus quam latioribus (in *D. aurea* ovatis, praecipue minus quam duplo longioribus quam latioribus), indumento abaxiali sparso fugacio, marginibus planis, floribus plerumque solitariis, haud in fasciculos densos aggregatis differt.

Typus: Borneo, Sabah, Gunung Tambuyukon, Kota Marudu District, 9th Oct 1995, *Argent & Smith* 395 (holo SNP: iso A. E. K. KEP, L. SAN, SING).

Figure 5

Spreading shrub to 70 cm tall. Branches laxly leafy. Stems laxly covered in appressed bristles. Petiole 2–4 x *c.* 1 mm, grooved above and with a few course appressed bristles. Leaf blade lanceolate or narrowly elliptic, 50–100 x 12–27 mm, coriaceous, glabrous and smooth above when dry, with rather sparse appressed bristles when very young and later punctulate from the remaining bases below; base rounded occasionally broadly cuneate; margin flat, entire, often with a persistent fringe of bristles, apex acute without a prominent terminal gland, midrib narrowly and slightly depressed above, distinctly raised below, lateral veins pinnate, arching upwards, mostly rather obscure, although with one or two clearly distinct in larger leaves.

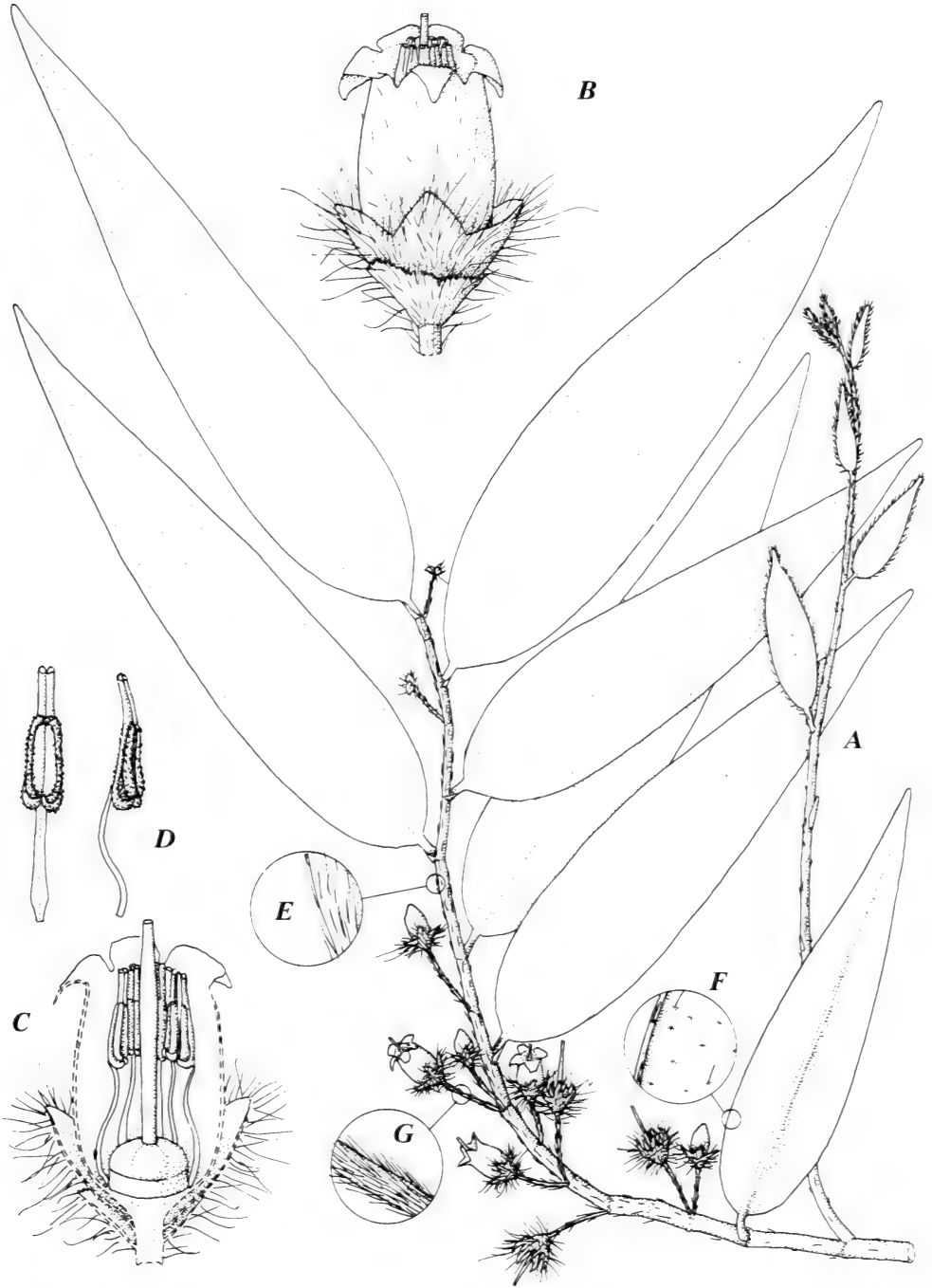


Figure 5. *Diplycosia paulsmithii* All from *Argent & Smith 395*: **A.** habit x 1 **B.** flower x 3; **C.** half flower x 3; **D.** stamens x 6; **E.** surface of young stem x 25; **F.** young abaxial leaf surface x 25; **G.** pedicel indumentum x 25.

Flowers mostly from upper leafy axils, solitary, 2 or 3 per axil; pedicels 7–9 x c. 0.5 mm, covered with appressed bristles, 4- and 5-merous flowers on the same plant. Bracteoles c. 1.5 mm wide, \pm semi-circular and fimbriate with glandular hairs round the margins and a few long coarse bristles abaxially. Calyx c. 2.5 mm long, tube c. 1 mm long, lobes, c. 1.5 mm long, triangular with broadly acute points, moderately densely setose abaxially with bristles up to 3 mm long, shortly glandular along the margins, no distinctively large gland at the apex. Corolla white c. 4 x 5 mm, tube with a very few sparse bristles outside, the lobes deltoid with a touch of purple at the apex, erect on opening but becoming reflexed, c. 1 x 1 mm, a distinct cluster of small bristles on the outside. Stamens 4.6 mm long, the filaments c. 2.1 mm long, glabrous, with anthers c. 2.5 mm long, tubules straight, c. 0.6 mm long. Disc glabrous; ovary glabrous, style, c. 3.3 mm, tapering upwards and glabrous. Fruit not known.

Notes: this is distinctive with the fully appressed stem bristles contrasting with the spreading bristles on the calyx. If the bristles on the undersides of young leaves can be observed, it keys directly in Argent (1989) to *Diplycosia aurea* Sleumer, but it differs both in leaf shape and in the much laxer indumentum that is fugaceous and not persistent. The inflorescences are very different in the two species. They are fasciculate tufts with matted golden hairs completely obscuring the short pedicels in *D. aurea*. In *D. paulsmithii* the flowers tend to be solitary or where fasciculate the individual pedicels are clearly discernable as they are more slender and covered with much less dense semi-appressed hairs. In Sleumer (1966–1967), *D. paulsmithii* keys out with the bristly species but at couplet 4, it does not agree with either lead as the bristles on the calyx are up to 3 mm long but they point in all directions and are clearly not appressed or suberect. Having bristles on the underside of the leaf (before they fall off) that are appressed, it again keys out to *D. aurea*. The second half of couplet 4 leads to *D. lilianae* J.J.Sm. from West New Guinea and *D. loheri* Merr. from the Philippines, both unlikely candidates given the local distributions of most montane *Diplycosia* species. *D. paulsmithii*, however, differs from *D. lilianae* as the bristles are not gland-tipped, and *D. paulsmithii* lacks the fine white hairs on the pedicels characteristic of *D. loheri*.

Diplycosia paulsmithii is relatively common on the upper part of G. Tambuyukon where it grows in semi-open areas amongst the ultramafic rocks, often as an epiphyte. It may well be endemic to this interesting mountain.

Specimens examined: Gunung Tambuyukon, camp III to summit *Nais et al.* SNP 4798, 5th Oct 1990 (KEP, SNP); cultivated specimen, the same locality,

flowering 20th Feb 2002 *Accession No.* 19952784 (E, SAN, SNP).

8. *Diplycosia ngii* Argent, *sp. nov.*

(Named after the collector Dr, Francis S.P.Ng, sometime Deputy Director General, Forest Research Institute Malaysia, Kepong, who has made an outstanding contribution to botany in Malaysia).

Diplycosiae pseudorufescenti similis sed indumento tenui albo sub setis grossis brunneis carenti, calyce abaxialiter breviter piloso (haud omnino glabro), foliis majoribus et pedicellis longioribus differt.

Typus: Peninsular Malaysia, Pahang, Gunung Jasar, summit area, 23rd Aug 1977, Ng FRI 27145 (holo KEP).

Figure 6

Shrub to 2 m tall. Branches laxly leafy. Stems terete, densely and subpatently setulose, covered with rufous semi-appressed bristles of differing lengths, without any finer pubescence. Petiole appressed setulose, 2–4 x 1–1.5 mm. Leaf blade ovate to ovate-elliptic, 23–35 x 12–19 mm. Young leaves densely appressed rufous-setulose on both sides, the mature leaves becoming glabrous above but mostly remaining appressed setulose below, finally in old leaves all the bristles are denuded to give a punctate surface, coriaceous; base rounded or more rarely broadly tapering; margin more or less revolute, at first with small bristles but these mostly early caducous to leave it minutely crenulate with impressed bristle bases; apex shortly acuminate, occasionally acute, terminal gland obscure, midrib impressed above, prominent beneath, lateral veins mostly two, basal or supra-basal, ascending, usually becoming obscure in the lower half of the leaf and before they reach the margin, occasionally visible to just over half way, rather obscure abaxially. Flowers axillary, solitary or paired pedicels *c.* 3 mm at flowering, later up to *c.* 6 mm long when in fruit, puberulous with crisped hairs, basal bracts, several, minute. Bracteoles *c.* 2 mm across, ovate, with involute sides and so appearing acute, shortly hairy abaxially. Calyx to *c.* 3 mm long, shortly hairy abaxially, lobes *c.* 2 mm long, acute with involute margins. Corolla tubular campanulate, glabrous, *c.* 4 mm long, lobes reflexed, to *c.* 0.5 mm long. Stamens *c.* 3.5 mm long, filaments slender, sigmoid, glabrous, *c.* 1.5 mm long, anthers *c.* 2.5 mm long, the cells *c.* 1.5 mm long, tubules *c.* 1 mm long. Disc glabrous; ovary rather densely grey-pubescent with erect hairs, style *c.* 3.5 mm long, glabrous. Fruit not known.

Notes: *Diplycosia ngii* keys out in Sleumer (1966–67) to *D. pseudorufescens* Sleumer, but differs from this species in not having the fine white patent puberulous tomentum under the coarse brown setose hairs, the leaves are

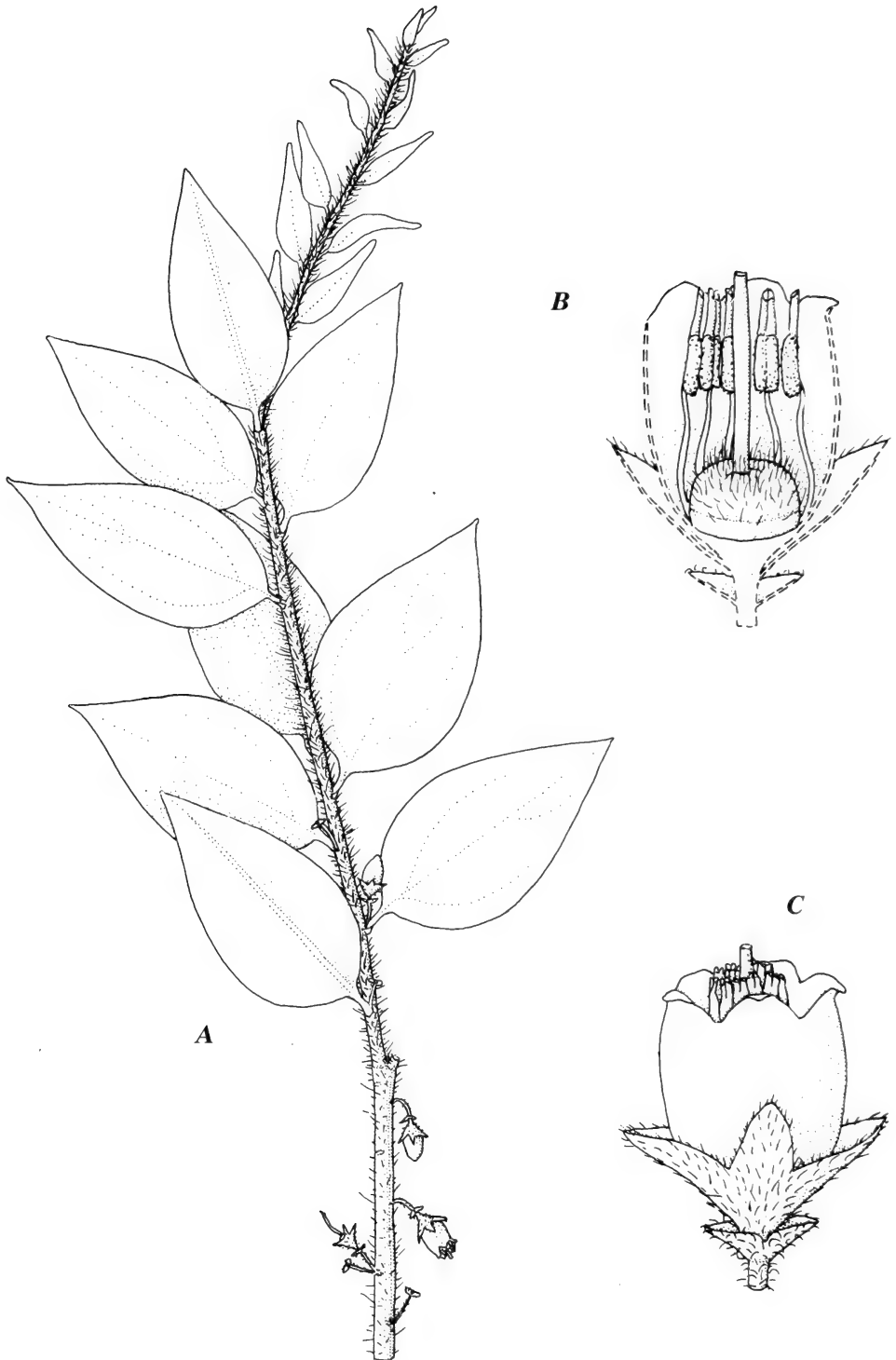


Figure 6. *Diplycosia ngii* All from Ng 27145: **A.** habit x 1; **B.** half flower x 9; **C.** flower x 9.

larger and the apical gland is not distinct, the calyx is shortly hairy abaxially (not glabrous) and the pedicels become much longer, up to 6 mm in fruit whereas in *D. pseudorufescens* they are not more than 3 mm. Type specimens of both subspecies of *D. pseudorufescens* have been examined but it has not been possible to locate the specimen collected on Gunung Korbu (Kerbau), Perak (Sleumer, 1966–67). Sleumer implied that this collection has the same characteristics of indumentum as the Kinabalu plants, the type locality of both subspecies of *D. pseudorufescens*. Clemens 29282 from Mt. Kinabalu is described with fruit, which suggests a real difference in the final pedicel length between *D. pseudorufescens* and *D. ngii*. The indumentum of bristles on the stems is reminiscent of *D. sumatrensis* Merr. from Sumatra (Indonesia) but both leaves and flowers are much smaller in this new species, which at present is only known from the type collection.

Reduction of *Pernettyopsis* to Synonymy with *Diplycosia*.

Pernettyopsis was described by King & Gamble (1905) with two species (*P. malayana* King & Gamble and *P. subglabra* King & Gamble) from Peninsular Malaysia. The second species was later reduced to synonymy by Sleumer (1966–1967) along with a third (*P. breviflora* (Ridl.)Ridl., which Ridley (1915) had originally described as a species of *Diplycosia*! Sleumer stated that “the wooly indumentum on the calyx lobes is apparently deterrent and early gone and the length of the pedicels varies” and concluded that there was material of only one species. *Pernettyopsis* was described as different from *Diplycosia* in that the fruit was a berry, the calyx was unchanged in fruit, i.e. was not accrescent and succulent, and was about as long as the corolla. A further species, *P. megabracteata* Argent, was described from Borneo in 1982. This latest species technically agreed with the description of *Pernettyopsis* but was very different to the original species having extraordinarily long acuminate bracteoles and very differently shaped flowers: ovoid cylindrical and more than twice as long as broad in *P. megabracteata*; short urceolate and hardly longer than broad in *P. malayana*.

The distinction between the fruits had already been questioned (Argent, 1982) and the definition of *Diplycosia* fruits as thin-walled capsules (Sleumer, 1966–1967) cannot be maintained. *D. acuminata* in Peninsular Malaysia clearly has an ovary that becomes enlarged and fleshy and behaves as a true berry. The calyx lobes of this species, although also accrescent, are much less so than in most other *Diplycosia* species and show a clear transition to the state in *Pernettyopsis*. Of many other species observed in the wild, the ovary never appears to split naturally and the fruit behaves

like a false berry although most of the 'attractive' flesh is associated with the calyx. That the calyx lobes are as long as the corolla in the two *Pernettyopsis* species would appear to be of no great significance as the flowers are of totally different shapes. Some of the very bristly *Diplycosia* species in Borneo, such as *D. rufa* Stapf, *D. aurea* Sleumer and *D. hirtiflora* Argent, also have long calyx lobes. There thus seems little point in maintaining the genus *Pernettyopsis* that is so weakly supported morphologically. Of the two currently recognized species, the original one (*sensu* Sleumer, 1966–1967) is frequently confused with *Diplycosia* and the second, although superficially very distinct from all other known *Diplycosia* species (Argent, 1982), is at least as different from the original *P. malayana*. Both these *Pernettyopsis* species share all the important structural characteristics of inflorescence and flower with *Diplycosia*. We do not have the anatomical evidence of Middleton (1989) but the conclusions drawn are parallel to those of Middleton & Wilcock (1990) to justify the inclusion of the genus *Pernettya* Gaudich. within *Gaultheria* Kalm ex L. Thus the genus *Pernettyopsis* is formally synonymised below with two resulting new combinations.

New Combinations

Diplycosia Blume, Bijdr. (1826), 857. **Type species:** *D. heterophylla* Blume, Bijdr 858 (1826).

Synonym: *Pernettyopsis* King & Gamble, J. As. Soc. Bengal, 74, 2 (1905) 79.

Type species: *P. malayana* King & Gamble, J. As. Soc. Bengal, 74, 2 (1905) 79.

Diplycosia malayana (King & Gamble) Argent, *comb. nov.*

Basionym: *Pernettyopsis malayana* King & Gamble, J. As. Soc. Bengal, 74, 2 (1905) 79.

Lectotype: *Scortechini* 402, Peninsular Malaysia, Gunung Batu Puteh.

Synonyms: *Pernettyopsis subglabra* King & Gamble, J. As. Soc. Bengal, 74, 2 (1905) 79.

Type: *Scortechini* 752, Perak.

Diplycosia breviflora Ridl., J. Fed. Mal. St. Mus. 6 (1915) 158.

Type: *Ridley s.n.* Pahang, Gunung Tahan.

Pernettyopsis breviflora (Ridl.) Ridl., Fl. Mal. Pen. 2 (1923) 222.

Diplycosia megabracteata (Argent) Argent, *comb. nov.*

Basionym: *Pernettyopsis megabracteata* Argent, Bot. J. Linn. Soc. 85 (1982) 10–12 f. 4. (1982).

Type: *Argent 824*, Sarawak, Gunung Mulu.

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New Gesneriaceae: a *Chirita* from Vietnam and a *Monophyllaea* from Sulawesi

B.L. BURTT

Royal Botanic Garden Edinburgh,
Edinburgh EH3 5LR, U.K.

Abstract

Chirita bogneriana B.L.Burttt is described from Ha Long Bay, Vietnam and *Monophyllaea chinii* B.L.Burttt from Maros, Sulawesi.

Chirita bogneriana

A few years ago, living material of a species of *Chirita* (Gesneriaceae) was sent to the Royal Botanic Gardens Edinburgh by Josef Bogner (Munich Botanic Garden, Germany) for identification, by no means the first interesting gesneriad that we have received from him. The plant originally came from Ha Long Bay in northern Vietnam. I was unable to identify this plant, but, learning of the survey being made there by Nguyen Tien Hiep and Ruth Kiew, I decided to wait and see if they too had collected this plant. Their results have now been published (Nguyen and Kiew, 2000) and they record seven species of *Chirita*: one of them is *C. hamosa* R. Br., which belongs to the distinctive section *Microchirita*; the remainder are referable to section *Gibbosaccus*, as is the Munich plant: but, although three new species were recognized, none of the species found by them fits this, which is accordingly described here as *C. bogneriana*.

The following description is based on a well-grown pot-plant. It is likely that it was larger and more floriferous than would be found in the wild, where the species almost certainly grows in crevices of limestone rock.

Chirita bogneriana B.L. Burttt, *sp. nov.*

(Sect. *Gibbosaccus* C.B. Clarke)

Typus: Vietnam, Ha Long Bay, spec. cult. in RBG Edinburgh (ex Bot. Gart. Muenchen comm. J. Bogner) under no. 19990640 (holo E; iso HN, K, M, SING).

Chirita hiepii Kiew (species in sinu Ha Long etiam incola) affinis sed foliis superne pilis brevibus inter se distantibus (nec pilis 4–6 mm longis

praecipue in marginibus) indutis; corollae limbo albo (nec purpureo), tubo ad basin laete luteo-viridi glabro (nec lineis duabus glanduloso-pilosis instructo) distinguenda.

Rosette herb with numerous ascending leaves and a vertical rootstock 2.5 cm diam. at top and rather abruptly narrowed at base. *Leaves* (including petiole) up to 10 cm long and 3 cm broad, lanceolate, gradually tapering into the 3.5 cm long flat petiolar part, the blade shortly pubescent above, the hairs well spaced (not overlapping) slightly longer and distinctly denser and appressed below, margin entire very slightly revolute, veins 4—5 on each side of midrib scarcely visible above, prominent below ascending at angle of 30°. *Inflorescences* compound pair-flowered cymes, solitary in the leaf axils, common peduncle 9—12 cm then branched, branches subtended by linear bracts 8 mm long, bracts and peduncle and whole inflorescence pilose with white gland-tipped hairs; branches usually branched again; whole inflorescence (in cultivated plant) 20—30 cm long, pedicels slender up to 6 cm long. *Calyx* tube 0.5 mm, lobes 8 x 1.2 mm, on the inside with minute globular glands and short (0.3 mm) acute hairs, on the outside with patent gland-tipped hairs 1—1.8 mm long. *Corolla* limb white, lobes glabrous inside, anterior lobes 6.5 x 5 mm, posterior 6 x 6 mm; tube 1 cm long, it and the outside of the lobes glandular-puberulous. *Stamens* arising 2.5 mm above base of corolla; the anterior pair fertile 5 mm long, rather thick, glabrous except for a few gland-tipped hairs near the connective, anthers 3.2 mm with widely divergent thecae; posterior pair 3 mm, sterile; dorsal staminode 0.5 mm. *Ovary* 6 x 1.3 mm, passing smoothly into 3 mm rather thick style, both with short hairs. *Stigma* with lower lobe bifid, upper aborted. *Fruit* not seen (seed is apparently not set on these plants).

Notes: *Chirita bogneriana* is most closely allied to *C. hiepii* Kiew, also from Ha Long Bay, but lacks the 4—6 mm long hairs on leaf margin and petiole which are a feature of that species. It also lacks the deep violet corolla lobes of *C. hiepii*, and the corolla tube is glabrous inside without the pair of glandular hairy bands of *C. hiepii*. From *C. halongensis* Kiew and T.H. Nguyen, it differs in the leaves being shortly pubescent, not glabrous, above and the veins on the under surface being distinctly prominent. *C. halongensis* shares with *C. hiepii* violet corolla lobes whereas the flowers of *C. bogneriana* are white, with just a greenish tinge at the base of the tube.

Monophyllaea chinii

This new species of *Monophyllaea* grows on limestone cliffs near Maros in

SW Sulawesi. It was first collected in 1986 by Dr S.C. Chin, well known for his revision of M.R. Henderson's account of the limestone flora of the Malay Peninsula. Ten years later, a second collection from the same general area, but from a different locality, was made by Dr. W. de Wilde and Dr B. de Wilde-Duyfjes. *M. chinii* belongs to subgen. *Monophyllaea* and is the first record of that subgenus from Sulawesi, the other monophyllaeas previously found on Sulawesi all belong to subgen. *Moultonia*.

Within subgen. *Monophyllaea*, *M. chinii* is to be associated with a small group of delicate species that has a rather scattered distribution and comprises species 13-16 in the revision of the genus (Burt, 1978). The species are *M. glabra* Ridl. from S Thailand and N Malaysia (Langkawi Islands), *M. hirticalyx* Franch. from C. Malaysia (Perak and Selangor), *M. musangensis* A. Weber (S. Kelantan – after the revision), *M. tenuis* B.L.Burt from the First (Kuching) Division of Sarawak, and the ill-known *M. longipes* Kraenzl. from the Philippine Island of Luzon.

The new *Monophyllaea chinii* is almost certainly an annual, as is *M. glabra*, which comes from an area with a distinctly seasonal climate. *M. tenuis*, certainly, and *M. hirticalyx* almost certainly, last for more than one flowering period. There remains much to be learnt about the duration of *Monophyllaea* and its control.

Although I have classified these delicate plants close to one another, it remains to be discovered whether they are really interrelated or whether each is more closely akin to more robust species in its own neighbourhood.

Monophyllaea chinii B.L.Burt, species nova ex affinitate *M. hirticalycis* Franch. et *M. tenuis* B.L.Burt sed plantis celebicis multo minoribus ut videtur annuis, caulibus pedunculis pedicellis pilis 1.5–2 mm longis indutis, pedicellis 8–12 mm longis patentibus, pilis in calyce 1.5 mm longis, interdum glandulosis distinguenda.

Typus: SW Sulawesi, Maros, Leangleang Prehistoric Park S.C. Chin 3408, 8 June 1986 (holo E; iso L) 'limestone hills, on vertical limestone cliff, flowers pale purple or white; small plants, longest leaf to 15 cm, stem to 15 cm'.

Stem (hypocotyl) slender, c. 3–10 cm long, pilose with patent hairs 2 mm long. Leaf solitary (macrocotyledon) 5–12 [–15 cm fide Chin] x 3–7.5 cm, more or less ovate, cordate at the base, thinly shortly hairy above, but with long hairs around the base of the peduncles which arise at the base of the midrib; lower veins matching the leaf outline, the lower ones strongly curved the upper ones straight. Peduncles 1–3, pilose with spreading hairs. Bracts absent. Inflorescence (incl. peduncle) up to c. 7 cm long, bearing

about 4—6 pairs of flowers, the lowermost pairs c. 1 cm apart. *Pedicels* strongly patent, 8—12 mm long. *Calyx* with tube 1 mm long, lobes 5 subequal c. 2.2 x 1.3 mm with slender hairs on the back c. 1.5 mm long some of them gland-tipped. *Corolla* bilabiate 10 mm long, tube 5 mm; lower lip 6.5 mm across minutely papillose inside, median lobe 3.5 x 3 mm, anterior laterals 3 x 3 mm, posterior 0.5 x 2.2. mm, glabrous; tube 5 mm long with a ring of hairs all round the inside just below the base of the filaments. *Stamens* 4, the fifth (dorsal) represented by a minute staminode; anterior pair with filaments 2.5 mm and anthers 0.8 mm long, posterior pair with filaments 1.5 mm and anthers 1 mm long, all filaments with a minute projection just below the anther, all anthers coherent. Disc annular 1.2 x 0.3 mm margin lobulate. *Ovary* conical 1 x 0.8 mm narrowed into 2 mm style, both glabrous; stigma 0.2 mm, slightly oblique, papillate. *Capsule* 1.5 x 1.5 mm, 2-(?finally 4-)valved, brown. *Seeds* 0.3 x 0.2 mm, light brown, coarsely reticulate.

Additional material: S W Sulawesi. Maros, NE of Wong Padang, c. 15 m alt., *W. de Wilde & B. de Wilde-Duyffjes* 21847 15 July 1996 (E, L) 'limestone rock area, on rather dry half-shaded rock, locally gregarious. Plants rather palish green, more or less juicy; flowers pale lilac.'

Acknowledgements

The floral dissections and sketches by O.M. Hilliard are acknowledged with thanks.

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A New Species of *Monophyllaea* (Gesneriaceae) from Borneo

R. KIEW

Singapore Botanic Gardens,
Singapore 259569

Abstract

Monophyllaea burttiana Kiew is described from Sabah, Malaysia.

Introduction

Since Burt's 1978 monograph on the genus, which described 32 species from Malasia, a further three species have been described from Peninsular Malaysia (Weber, 1998). There are undoubtedly more species to be discovered in remote parts of the region. *Monophyllaea burttiana* Kiew (described below) is the second species to be recorded from Sabah.

***Monophyllaea* in Sabah**

Unlike Sarawak, where there is a wealth of *Monophyllaea* species (14 species), until now only one species, the widespread *M. merrilliana* Kraenzl. was recorded from Sabah. Indeed, while in Sarawak monophyllaeas are a characteristic feature of limestone hills, Sabah is in marked contrast with all except two of the 60 odd hills being devoid of them. *M. merrilliana* only occurs on limestone in the Tabin Wildlife Sanctuary in eastern Sabah, where it does not grow on cliff faces but instead on and among the scattered limestone boulders in the damp, deep shade around the hill (Kiew, 2001). In Sabah, it is more common and has been collected from non-limestone substrates, e.g. from Gunung Kinabalu, Gunung Trusmadi and the Danum Valley.

In contrast to *Monophyllaea merrilliana*, this new species covers a vertical limestone cliff face of the unique below-ground, bowl-shaped gorge at Batu Urun. It is immediately distinguished from *M. merrilliana* by its uniseriate (not branched) hairs and unbranched inflorescences although it does belong to the same subgenus *Moultonia* in possessing anchor-shaped placentas and non-valvate fruits.

Among the species in subgen. *Moultonia*, most of which occur in

Borneo, it keys out with *M. glauca* C.B. Clarke in having unbranched inflorescences at the base of the midrib and a short way up it, in having unbranched hairs, and in the fruit where the style is not exerted beyond the calyx. It is distinct from this species in its shorter peduncle (up to 11 cm long as opposed to 15–25 cm long in *M. glauca*), which is three times longer than the flowering part (as opposed to only a fifth or less in *M. glauca*), as well as its longer calyx, glabrous corolla lobes, larger anthers, and leaf base that is only slightly cordate.

Observations in the field show that the differences between the two subgenera are strongly correlated with seed dispersal. As Burt (1978) pointed out, the fruit of subgen. *Monophyllaea* with long pedicels and four valves are censer fruits where the seeds are dispersed when shaken out by wind or other means. On the other hand, the fruits of subgen. *Moultonia* are typical splash cups, a mode of dispersal common to many other species of rainforest understorey herbs (Kiew, 1988), such as species of *Argostemma* (Rubiaceae), *Epithema* (Gesneriaceae), *Phyllagathis* and *Sonerila* (Melastomataceae), in having short erect pedicels, calyx lobes that open to about 45° and the top of the pericarp that falls off to expose the minute seeds in the splash cup. In this new species, the style base is inflated and hollow and breaks down to expose the seeds. The ballistic force of large water drops dripping through the canopy can bounce the seeds several meters from the parent plant (Savile and Hayhoe, 1978). When dispersal does not occur, the seeds germinate within the open splash cup.

***Monophyllaea burttiana* Kiew, sp. nov.**

A *Monophyllaea glauca* C.B. Clarke inflorescentiis brevioribus, ad 11 cm tantum (nec 15–25 cm), corollae lobis glabris et folio non nisi leviter cordato differt.

Type: Borneo: Sabah – Pensiangan District, Batu Urun (lat 4° 48' N long 116° 38' E) J.J. Vermeulen 2100 16 Feb 2001 (holo SING, iso E, L, SAN).

Stem fleshy, up to 35 cm long (not encrusted). *Leaf* pendent, c. 22–23 cm long but much decomposed at the tip, broadly ovate and up to 26 cm wide or broadly oval and c. 22 cm wide, base slightly cordate, thin, slightly rough and densely hairy above, less hairy beneath, hairs uniseriate c. 1 mm long and raised on a hemispherical base, veins plane above, slightly raised beneath. *Inflorescences* arising from the base of the midrib and c. 3.5 cm up the midrib, unbranched with green peduncle (2.5–)11 cm long, densely pilose with uniseriate glandular hairs, flowering part scorpioid with c. 4 rows of flowers, upto 4.5 cm long, not persistent; bract pair reflexed c. 3 x 2

mm; pedicel pilose, erect, 3—5 mm long. *Calyx* c. 8 mm long, deep purple or purple brown, densely pilose outside, tube c. 1.5 mm long, lobes isomorphic, apex acute. *Corolla* c. 9 mm long, 4 mm wide, white with green upper lobes and yellow patch in the throat, tube c. 4.5 mm long with a ring of sparse hairs inside about midway up the tube, hairs extending towards upper lobes, lobes glabrous, upper lobes strongly reflexed, c. 3.5 x 3.5 mm, lateral and median lobes isomorphic, c. 4.5 x 3.5 mm. *Stamens* with green filaments, both pairs arising c. 2.5 mm from base of corolla tube, anterior c. 3 mm long and curved, posterior c. 1.5 mm and straight, anthers yellow, c. 1 mm diam., connate and filling the mouth of the corolla tube. *Disc* c. 0.5 mm high. *Ovary* c. 1 mm long, glabrous; style c. 2 mm long, placentas anchor-shaped in TS. Calyx closes over ovary after pollination, opening with lobes at 30° on fruit maturity and forming a splash cup. Pedicel lengthening to 11 mm. *Fruit* globose, c. 1.5 x 1.25 mm, pericarp thin topped by hollow inflated style base, style c. 2.5 mm long enclosed in the calyx in developing fruit, caducous in mature fruit. *Seeds* many, ellipsoid, tiny c. 0.3 mm long, smooth and jet black.

Distribution: Endemic to Sabah, Borneo, known only from Batu Urun.

Habitat: Deeply shaded limestone cliff face at c. 600 m altitude.

Notes: This species is extremely local being known from a single population that covers a rock face measuring about 20 by 15 m.

The species is named for B.L. Burtt, who for a life-time has worked assiduously on the genus and the family and been an inspiration to others.

Other specimens examined: Lamb B85 (E), Kiew RK 4444 20 May 1997 (SAN, SING).

Acknowledgements

The author is indebted to Anthony Lamb and his staff at the Tenom Orchid Centre for taking us to the inaccessible Batu Urun, to the staff at the Forest Research Centre, Sandakan for their expert help in the field and to B.L. Burtt for improving the latin diagnosis.

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A New Species of *Vatica* (Dipterocarpaceae) from Peninsular Malaysia

L.G. SAW

Forest Research Institute Malaysia,
Kepong, 52109 Kuala Lumpur, Malaysia

Abstract

A new species of Dipterocarpaceae, *Vatica yeechongii* L.G. Saw is described from Peninsular Malaysia. The species is currently known from only two localities: the type locality at Sungai Lalang Forest Reserve, Selangor, and the Setul Forest Reserve, Negri Sembilan.

Introduction

The genus *Vatica* comprises about 65 species (Ashton, 1982) distributed in Sri Lanka, southern and eastern India, Myanmar, Thailand, Indochina, south China and through Malesia. In the most recent revision for the genus for the Malesian region, Ashton (1982) recognised 21 species in Peninsular Malaysia. Based on fruits, the genus can be divided into two sections, viz., sect. *Vatica* (with fruit calyx lobes equal) and sect. *Sunaptea* (with fruit calyx lobes unequal). In the recent mast flowering in Peninsular Malaysia (mid-2002), a *Vatica* was collected from the Sungai Lalang Forest Reserve that proved to be a new species belonging to sect. *Vatica*.

The species has unusually large leaves and the fruits are similar to those of *Vatica havilandii* Brandis, *V. venulosa* Blume and *V. chartacea* P.S. Ashton but its size, the leaves and fruits are much larger than those of these three related species (Table 1).

Vatica yeechongii L.G. Saw, sp. nov.

Vaticae venulosae similis, sed foliis crasse coriaceis supra bullatis oblanceolatis 44–84 cm longis 10–16.5 cm latis, basi anguste contracta in basi cordata, acumine 1.5–2.5 cm longo, calycis lobis 3.5–4 cm longis, et nucis ovoidea 15–18 mm diam. differt. **Typus:** Peninsular Malaysia, Selangor, Sungai Tekala Recreational Forest in Sungai Lalang Forest Reserve, fr. 11 July 2002, Chung FRI 40344 (holo. KEP; iso. A, K, L, KLU, SAN, SAR, SING).

Table 1. Comparison of *Vatica yeechongii*, *V. chartacea*, *V. havilandii* and *V. venulosa*.

	<i>V. yeechongii</i>	<i>V. chartacea</i>	<i>V. havilandii</i>	<i>V. venulosa</i>
Leaves:				
petiole				
length (mm)	20–30	10–22	10–12	5–9
blade				
texture	thickly coriaceous, bullate above	thinly chartaceous	thinly coriaceous	thinly coriaceous
shape	oblanceolate	oblong to obovate	narrowly oblong to obovate	elliptic to ovate-lanceolate
length (cm)	44–84	11–25	8–17	4–12
width (cm)	10–16.5	3–10	2.5–5	1.5–5
base	tapering narrowly to a cordate base	broadly cuneate or obtuse	cuneate	cuneate
acumen length (cm)	1.5–2.5	1	1	up to 0.5
no. of secondary veins	28–30 pairs	16–20 pairs	15–20 pairs	7–12 pairs
Fruits pedicel				
length (mm)	2–3	up to 6	up to 5	up to 2
Calyx lobes				
length (cm)	3.5–4	up to 6	up to 2.5	up to 3
width (cm)	1–1.5	up to 1.5	up to 1.5	up to 1.3
shape	ovate	lanceolate	ovate	ovate
Nut				
shape	ovoid	ellipsoid	globose	globose
diameter (mm)	15–18	up to 11	up to 12	up to 10

Figure 1

Small tree, 8–15 m tall, 9–13 cm diam., without buttresses. *Bark* smooth with horizontal rings, greyish white with lichen patches; inner bark yellowish-brown; sapwood pale, hard, exuding creamy white resin when cut. *Twigs* robust, 1–2 cm diam., densely rufous stellate hairy when young. *Stipules* narrowly triangular in shape, often curving to one side, 20–35 x 5–8 mm, subpersistent. *Leaves* spreading horizontally to slightly drooping, thickly coriaceous, bullate above, glossy dark green above, pale green below when fresh, glabrescent; petiole 20–30 mm long, 9–13 mm thick, swollen, cracking when dried, densely rufous stellate hairy; blade oblanceolate, 44–84 x 10–16.5 cm, tapering narrowly to a cordate base, margin entire, apex acuminate, acumen 1.5–2.5 cm long; midrib very stout and prominent below, raised above; secondary veins 28–30 pairs, prominent below, distinctly raised

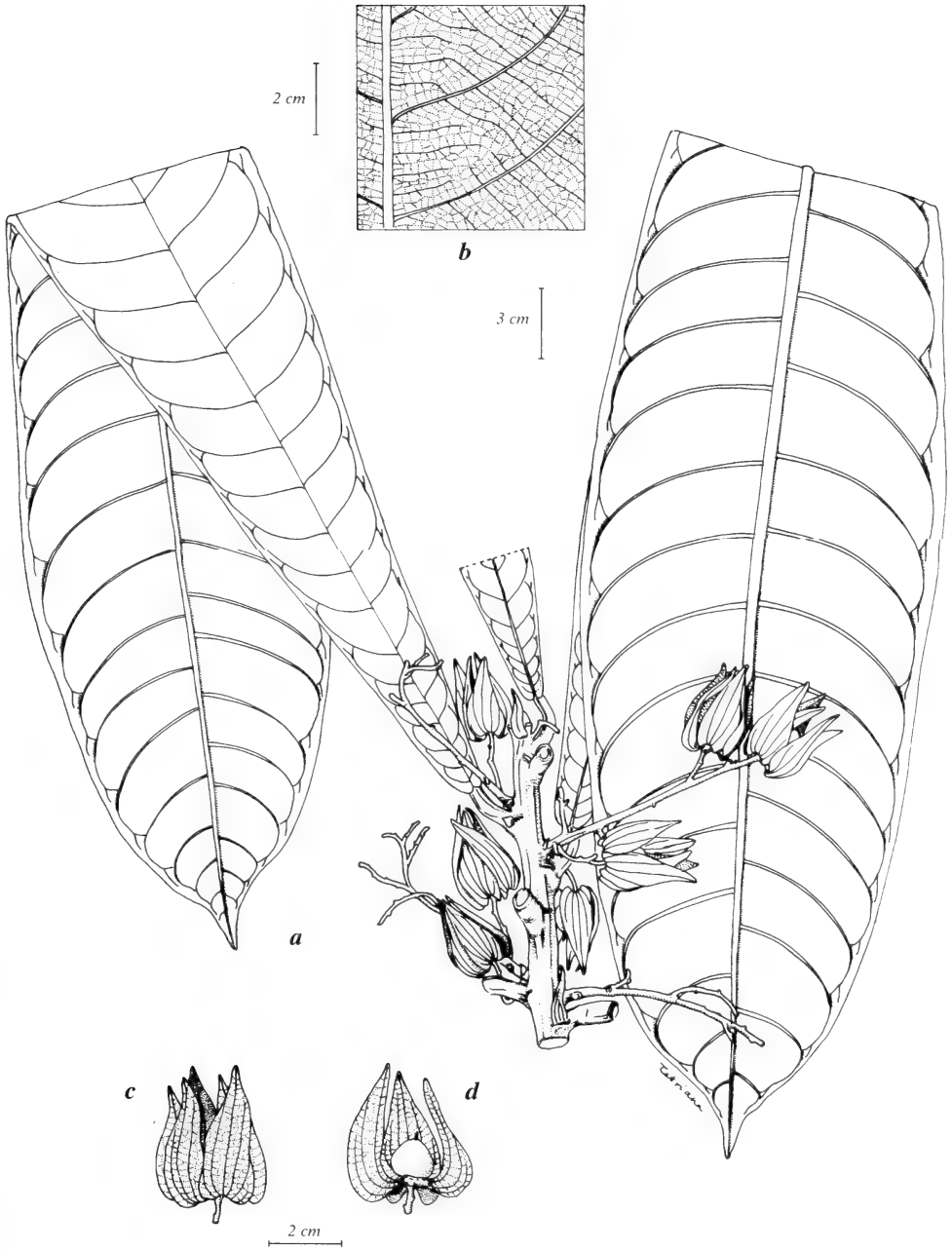


Figure 1. *Vatica yeechongii*. A. leafy fruiting twig; B. details of lower surface of leaf; C. fruit; D. fruit with two calyx lobes removed. (All from Chung FRI 40344)

above; intermediate veins 2–4, with the middle one longer than the rest, 3–3.5 cm from the midrib; tertiary veins scalariform-reticulate, conspicuous above; linear domatia sometimes present along distal portion of secondary veins at junction joining preceding veins. *Flowers* unknown. *Infructescence* axillary, 1 per node, along branches of the leafy shoots, branching to only 1 order, short, densely rufous stellate hairy; rachis 4–8 cm long, *c.* 2 mm thick at base and tapering to *c.* 1 mm thick apically. *Fruits* along main rachis and on first order branches; *pedicel* 2–3 mm long, *c.* 1 mm thick, densely rufous stellate hairy; *calyx lobes* green to reddish brown when fresh, 3.5–4 x 1–1.5 cm, ovate, acute, connate up to 4–5 mm from the base, glabrescent; *nut* ovoid, 15–18 mm in diameter, glabrescent, completely hidden in, but free from, the calyx lobes. *Germination* epigeal.

Distribution: Endemic to Peninsular Malaysia. Rare, known from the Sungai Lalang Forest Reserve, Selangor, and the Setul Forest Reserve, Negri Sembilan.

Habitat: It was found in lowland dipterocarp forest, at about 50 m altitude, on a gentle slope near the riverbank in the Sungai Lalang Forest Reserve in association with *Saraca cauliflora* Baker (Leguminosae). The fruits appear to be water dispersed. Of the nine mature trees the Forest Research Institute Malaysia (FRIM) team managed to locate, all were within 5 m of the stream bank, where the gradient of the stream is gentle. We were unable to locate trees on the upper slopes of the river valley nor on the banks further upstream where the stream is torrential. In the Setul Forest Reserve, the species was also observed in a similar habitat.

Notes: The growth pattern on shoots is rhythmic: on the stem there are obvious resting periods where nodes are close together, followed by elongation periods of leaf-free growth with only stipules, then followed by a cluster of spirally arranged leaves. Largest leaves are found on the proximal ends of these clusters, the distal ones are smaller.

Chan Yee Chong, FRIM Research Assistant, had noted this species as an unnamed *Vatica* sometime ago and during the recent mast flowering and fruiting, he managed to collect fruiting material, which enabled the description of this new species. The species epithet honours Chan Yee Chong.

Other specimen examined: Peninsular Malaysia – Selangor: Sungai Tekala Recreational Forest in the Sungai Lalang Forest Reserve, close to ranger's office and camping site, fr. 3 July 2002, *Y.C. Chan FRI 46657* (KEP); Negri

Sembilan: Setul Forest Reserve, fr. 20 Aug 2002, *Y.C. Chan FRI 46668* (KEP).

Acknowledgements

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The Identity of *Swietenia alternifolia* (Mill.) Steud. (‘Meliaceae’)

D.J. MABBERLEY

Nationaal Herbarium Nederland, University of Leiden, The Netherlands ;
Royal Botanic Gardens Sydney
Mrs Macquaries Road, Sydney 2000, Australia*

Abstract

Swietenia alternifolia (Mill.) Steud., formerly referred to Meliaceae, is a species of *Luehea* Willd. (Malvaceae, *s.l.*): the appropriate new combination, *L. alternifolia* (Mill.) Mabb. (syn. *L. speciosa* Willd.), is therefore proposed.

Introduction

In the disposing of names to be excluded from Meliaceae in an account of that family being prepared for Kubitzki's *Families and Genera of Vascular Plants*, the binomial *Swietenia alternifolia* (Mill.) Steud., i.e. *Cedrus alternifolia* Mill. (*Cedrela alternifolia* (Mill.) Steud.), has had to be considered. That species described by Philip Miller (1691–1771) was based on the field notes made in 1730–1 in Campeche, Mexico, by William Houstoun (1695–1733) - the British surgeon who trained under Boerhaave in Leiden - combined with observations on plants raised by growers in England, including plants grown in the Chelsea Physick Garden from seeds sent by Houstoun. In his description of the new species, Miller (*Gard. Dict.* ed. 8, *Cedrus* n. 3, 1759) noted, “The third Sort [of *Cedrus*, i.e. *Cedrela*] was discovered by the late Dr *Houstoun* at Campeachy, from whence he sent Seeds to *England*, which succeeded in several Gardens; when the Doctor first observed these Trees, they were destitute of Leaves, but were loaded with ripe Fruits; and on his second Visit to the Place he found the Trees in full Verdure”.

The plant is recorded by George Don in his *General History* (1831; see below) as if still being cultivated in England, but it seems never to have flowered there, and, in the *Flora neotropica* monograph dealing with the mahogany genus, *Swietenia* Jacq., Styles (in Pennington and Styles 1981: 385, 405) rejected it from the family Meliaceae, though he did not suggest any other disposition for it.

Houstoun's MS description quoted by Miller, “Arbor excelsa Coryli folio ampliore”, is his ‘C[ampichianus ager]. Coryli folio arbor’ of f. 101 in

*Address for correspondence

Catalogus plantarum in America observatarum by Mr Wm HOUSTON (MS Banks 67, The Natural History Museum, London). This entry is accompanied by the note, 'spec.', indicating that a specimen was preserved. Houston's herbarium specimens were bequeathed to Miller (Dandy 1958 : 139–140) and, in 1774, Miller's collection was bought by Sir Joseph Banks, whose own herbarium came in 1827 to the British Museum, now the herbarium (BM) of The Natural History Museum, London.

The MS description, combined with Houston's other observations and records set out above, show that he had found in the Campeche area a large, deciduous tree with simple, alternate, large, hazel-like leaves and *Cedrela*-type fruits - and that he had collected a specimen of it.

The description is very strongly reminiscent of the plant more recently grown, albeit only occasionally, in some tropical botanic gardens (e.g. Bogor, Indonesia [Danimihardja & Notohardjo 1978 : 153] and Penang, Malaysia [*Cheang Kok Choy s.n.*, Nov. 1966 – L !, SING]) as *Luehea speciosa* Willd. (Malvaceae, *s.l.*), a tree native in the Neotropics. This is a species known from Yucatán and, sure enough, an excellent flowering specimen, collected by Houston, complete with his MS label, 'Coryli folio arbor C[ampeachy] MSS', is filed with other Mexican material of *L. speciosa* at BM. The correct disposition of *Swietenia alternifolia* is therefore under *Luehea*.

New Combination

Luehea alternifolia* (Mill.) Mabb., *comb. nova

Cedrus alternifolia Mill., Gard. Dict., ed. 8, Cedrus n. 3 ("alternifolius", 1759) & ed. 9 : Cedrus n. 3 ('alternifolius', 1768); Chaz., Dict. Jard. 3: 332 ("alternifolius", 1785) - *Cedrela alternifolia* (Mill.) Steud., Nomencl. 1: 170 (1821); DC., Prodr. 1: 625 (1824); G. Don, Gen. Hist. 1: 687 (1831); M. Roem., Fam. Nat. Syn. Monogr. 1: 136 (1846); C.DC., in DC., Monog. Phan. 1: 747 (1878); Styles, Fl. Neotropica 28 : 385 (1981).- *Swietenia alternifolia* (Mill.) Steud., Nomencl., ed. 2: 653 (1841); Styles, op.cit. : 405 (1981).

Type: Mexico, Yucatán, Campeche, 1730–1, *Houston s.n.* (BM !, neo, **selected here**. In his description, first printed in ed. 7 (1757) of his *Gardeners Dictionary*, Miller made no mention of flowers, strongly suggesting that this Houston specimen was not taken into account when the description was originally drawn up – indeed, if it had been, Miller would no doubt not have named it as he did !).

Luehea speciosa Willd. in Neue Schr. Ges. Naturf. Fr. Berlin 3: 410, t. 5 ('*Lühea*', 1801); Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 9: 831 (1926), **synon. nov.**

Type: [Venezuela,] 'Auf dem Gipfel des hohen Gebirges zwischen la Gauyana [sic] und Caracas', January, *Bredemeyer s.n.* in Herb. Willdenow 14376 (B-WILLD, fiche!).

Acknowledgements

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Nepenthes platychila (Nepenthaceae), a New Species of Pitcher Plant from Sarawak, Borneo

CH' IEN C. LEE

Malesiana Tropicals, Kuching, Malaysia

Abstract

Nepenthes platychila Chi.C. Lee, a new species from the Hose Mountains in central Sarawak, Borneo, is described and illustrated.

Introduction

The Hose Mountains is a remote and relatively isolated mountain range located in central Sarawak between the watersheds of Sungai Baleh and Sungai Balui. Botanically, the region was poorly known in the last century largely due to difficulty of access and the extremely rugged topography. Recent expeditions, however, indicate that the region is a very important centre of diversity for *Nepenthes* in Sarawak from where a total of eight taxa have been so far recorded (Lee, 2002).

During an expedition to the Hose Mountains in December 2001, on the lower slopes of Gunung Bukit Batu, plants of an unusual taxon of *Nepenthes* were found that did not match any described in Clarke (1997). The extraordinary form of the pitcher peristome immediately suggested that these plants belong to a previously unrecognized species. Specimens collected on this expedition were deposited in the Kuching Herbarium (SAR) and comparison with material from previous collections and other possibly related species, confirmed that it is new. The description below follows the conventions of Danser (1928) as maintained by Cheek and Jebb (2001).

Nepenthes platychila Chi.C. Lee, *sp. nov.*

Nepenthi fuscae Danser similis sed peristomio lato expanso, operculo lato ovato, facie inferiore plana (sine appendice lateraliter applanata) differt –
TYPUS: Gunung Bukit Batu, Hose Mountains, Sarawak, 30 Nov 2001, C. Lee S 87071 (SAR).

Figure 1

Terrestrial or epiphytic climber to 4 m tall. Indumentum present on all parts, very dense on stems, tendrils, young pitchers and inflorescence, consisting of red-brown hairs 0.5–1 mm long, branched at the base; upper surface of leaf lamina fairly densely pubescent with short white stellate hairs 0.1–0.3 mm long. Climbing stems terete, 5–8 mm diam., internodes 6.5–8.5 cm long, axillary buds spike-like. Leaves of the climbing stems coriaceous, blade oblong-elliptic, 10.5–18 by 3.8–4.6 cm, dark greyish-green occasionally purple-green, upper pitchers light-green with abundant red streaks, peristome yellowish-green with numerous purple-red streaks of varying width, apex usually obtuse, occasionally sub-peltate, base clasping the stem for 1/2–2/3 its circumference and decurrent for more than half the internode, gradually attenuate into the winged petiole; longitudinal veins 2 or 3 on each side of the midrib, pennate veins reticulate and inconspicuous. Lower pitchers unknown. Upper pitchers narrowly infundibular in lower half, broadly infundibular in upper half; 12.5–16.5 by 5.1–6.5 cm; ventral ridges indistinct; mouth sub-orbicular to slightly ovate, horizontal in front and elevated towards lid; peristome flattened and expanded, to 3.3 cm wide, ribs indistinct; inner surface glandular throughout; spur inserted 1 mm from base of lid, 2 mm long; lid ovate or orbicular-ovate, rounded or slightly cordate at base, to 4.8 x 4.4 cm, lower surface without appendages, often slightly keeled in the basal part of the midrib, with scattered small crater-like glands most abundant on either side of the midrib. Bracts absent. Male inflorescence: peduncle 8 cm long, rachis 23 cm long; partial peduncles 2-flowered, to 4 mm below the branch, with each branch to 12 mm long; sepals ovate-elliptic, 3–4 mm long; staminal column 4–5 mm long. Female inflorescence not seen. Infructescence similar in structure to the male inflorescence, bearing up to c. 100 fruits; peduncle to 12.5 cm long, rachis to 16 cm long; mature fruits 3.5–4.5 cm long.

Distribution: Borneo: SARAWAK - Kapit Division, Hose Mountains, Gunung Bukit Batu and Bukit Sindap.

Habitat: Growing epiphytically in moss forest or terrestrially on steep sandstone slopes among *Dicranopteris* and *Dipteris* ferns, 900–1400 m elevation.

Notes: This species is readily distinguished by the unique form of its peristome, which is greatly expanded and almost completely smooth on its upper surface. The size of the peristome is variable within the species, but, in its most extreme form, it is so wide that the entire pitcher is hidden

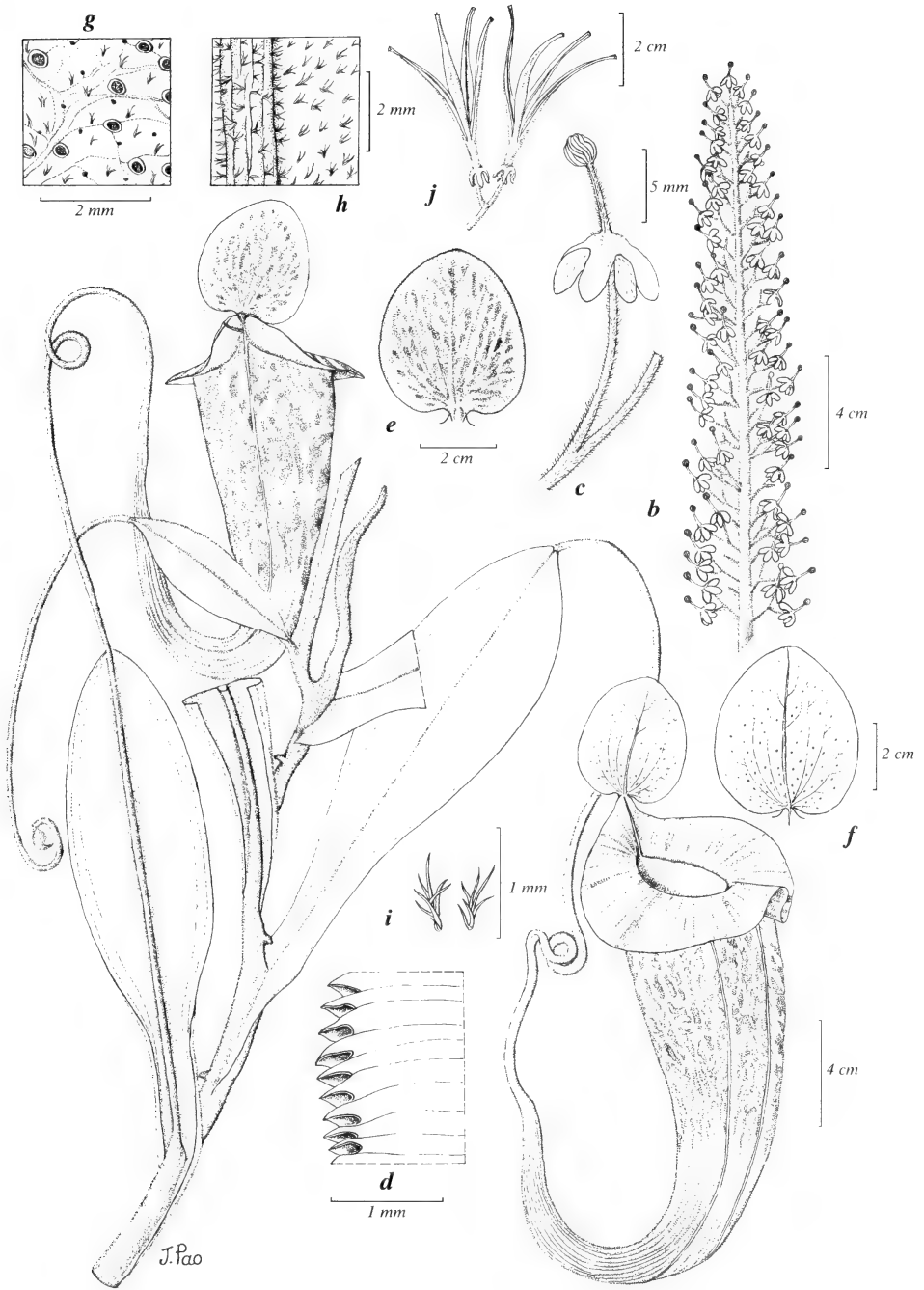


Figure 1. *Nepenthes platychila* Chi.C. Lee

a. Habit with upper pitchers; b. male inflorescence; c. male flower; d. detail of peristome, internal view; e. upper surface of lid; f. underside of lid; g. detail of glands of lower lid surface; h. detail of hairs on underside of lid; i. detail of hairs; j. fruit. (a-i from S 87071, j from S 87074).

beneath it when viewed from above. The only other species in the genus bearing a similar peristome structure is *Nepenthes jacquelineae* C. Clarke, T. Davis & Tamin of West Sumatra, but these two species appear to be otherwise unrelated. It is unclear what purpose the unusual structure of the peristome serves, but it may provide a convenient landing platform for potential insect prey or as suggested by Clarke (2001) for *N. jacquelineae* assist in luring insects by making the pitcher mouth appear brighter than the surroundings.

Nepenthes platychila is clearly a member of Danser's Regiae group, and within this group it is probably most closely related to *N. fusca* Danser by the similar pitcher shape and other vegetative features. However, the distinctive peristome and broad lid without appendages separate these two taxa, and indeed serve to distinguish this species from all others in the Regiae group. Other unusual characteristics of this species include the long pedicels and extraordinarily large mature fruits.

Observations in the field, and the fact that no rosette plants or lower pitchers have yet been collected, suggest that this species enters a climbing stage relatively early in growth.

This species is sympatric with *Nepenthes fusca*, *N. pilosa* Danser, *N. reinwardtiana* Miq., *N. tentaculata* Hook f., and *N. veitchii* Hook f. A single plant at the type locality displaying characteristics intermediate between *N. platychila* and *N. fusca* may be a natural hybrid between these two species.

Although so far known from only a few localities, it is unlikely that this species is restricted to Gunung Bukit Batu and Bukit Sindap, since suitable habitat conditions occur extensively throughout the Hose Mountains.

Other specimens examined: SARAWAK: Hose Mountain, Sungai Temiai, Mujong, 1260 m, 6 Dec 1991, *Lai, Jugah, Awg. Enjah S 64084* (KEP, SAR); Bukit Sindap, Hose Mountains, 1100 m, 1 Dec 2001, *C. Lee S 87074* (K, SAR).

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Leaf Epidermal Micromorphology of *Grewia* L. and *Microcos* L. (Tiliaceae) in Peninsular Malaysia and Borneo

R. C. K. CHUNG

Forest Research Institute Malaysia
Kepong, 52109 Kuala Lumpur, Malaysia

Abstract

Leaf epidermal morphology of 5 species of *Grewia* L. and 32 species of *Microcos* L. (including their type species) were examined. *Grewia* and *Microcos* both have glandular and non-glandular trichomes. Trichome characters alone cannot be used for delimiting *Grewia* from *Microcos* or for distinguishing species within each genus. Five epidermal characters were useful for distinguishing the two genera in Peninsular Malaysia and Borneo. *Grewia* species differ from *Microcos* species in having radiating cuticular striation of epidermal/subsidiary cells, predominantly anomocytic stomata, stomata elliptic to broadly elliptic in outline with mean length 18.6–22.9 μm and average length-width (L/W) ratios of 1.2–1.4. The *Microcos* species were characterised by the absence of radiating cuticular striation of epidermal/subsidiary cells (except in *M. tomentosa*), predominantly paracytic and anisocytic stomata, stomata broadly elliptic to oblate in outline with mean length 12–16.4 μm and average L/W ratios of 0.9–1.1.

Introduction

The genus *Grewia* consists of about 200 species of small trees and shrubs or rarely scandent shrubs, distributed from tropical Africa northwards to the Himalayas, China and Taiwan, south eastwards to India, Sri Lanka, Myanmar, Thailand, Indo-China, Malesia, Tonga, Samoa and the northern parts of Australia. In Malesian region about 30 species are known, of which 4 occur in Peninsular Malaysia and Borneo. *Microcos* is a genus of about 80 species of trees and shrubs, occurring in tropical Africa, India, Sri Lanka, Myanmar, Indo-China, S China, Hainan, Thailand, and throughout Malesia except for the Lesser Sunda Islands. In Malesia, some 42 species are known, of which 31 occur in Peninsular Malaysia and Borneo (Boer and Sosef, 1998; Phengklai, 1998; Chung, 2001). For species in Peninsular Malaysia and Borneo, a total of 13 macromorphological characters have been identified as diagnostic for distinguishing *Microcos* species from those of *Grewia* (Chung, 2001).

The taxonomic value of leaf epidermal structures is well documented (Wilkinson, 1979; Theobald *et al.*, 1979). In the order Malvales, to which

the Tiliaceae belong, epidermal characters, particularly the type and distribution of trichomes and stomata, are reported useful for delimiting and/or distinguishing taxa at subfamily levels (Metcalf and Chalk, 1950; Inamdar and Chohan, 1969; Rao and Ramayya, 1977; 1983; Inamdar *et al.*, 1983; Salma, 1999).

Work on organography as well as taxonomic significance of leaf epidermal characters in the order Malvales is meagre (Solereeder, 1908; Metcalfe and Chalk, 1950). In the Tiliaceae, studies on the taxonomic significance of epidermal characters are very scanty and limited to very few genera from India, i.e. *Berrya* (Inamdar *et al.*, 1983; 1 species), *Corchorus* (Rao and Ramayya, 1981; 1984; 1987; Inamdar *et al.*, 1983; Rao, 1990; Sharma, 1990; Singh and Dube, 1993; 8 species), *Grewia* (Tiwari, 1978; Rao and Ramayya, 1981; 1984; 1987; Inamdar *et al.*, 1983; Sharma, 1990; 32 species), *Microcos* (Inamdar *et al.*, 1983; Sharma, 1990; 1 species), *Triumfetta* (Rao and Ramayya, 1981; 1984; 1987; Inamdar *et al.*, 1983; Rao, 1990; Sharma, 1990; 5 species).

Likewise, the significance of trichomes in plant systematics has long been recognised in the classification of angiosperms (Davis and Heywood, 1963; Edmonds, 1982). Previous studies on the trichome morphology and distribution in the Tiliaceae were conducted by Metcalfe and Chalk (1950), Kostermans (1972), Morawetz (1981), Rao and Ramayya (1987), Rao (1990), and Sharma (1990).

The aim of the present study is to investigate the micromorphological variability of the leaf epidermis and to assess its taxonomic significance in the Peninsular Malaysian and Bornean *Grewia* and *Microcos*.

Materials and methods

Most leaf material investigated was obtained from herbarium specimens available at the Forest Research Institute Malaysia (KEP), unless stated otherwise (herbarium abbreviations as in Holmgren *et al.*, 1990). The species and specimens studied are listed in the Appendix.

Fully developed leaves were selected from dried herbarium specimens. For each leaf, an area from the middle of the lamina, including midrib and leaf margin, was taken. All material was rehydrated in water prior to cuticular maceration in Jeffrey's solution (a mixture of equal volumes of 10% chromic acid and concentrated nitric acid), stained in a solution of Sudan IV in alcohol 70% and mounted in glycerin-jelly. For scanning electron microscopy (SEM), samples of dried leaf specimens (adaxial and abaxial surfaces) were directly mounted on stubs and coated with gold and observed under a JOEL JSM-6400 scanning electron microscope.

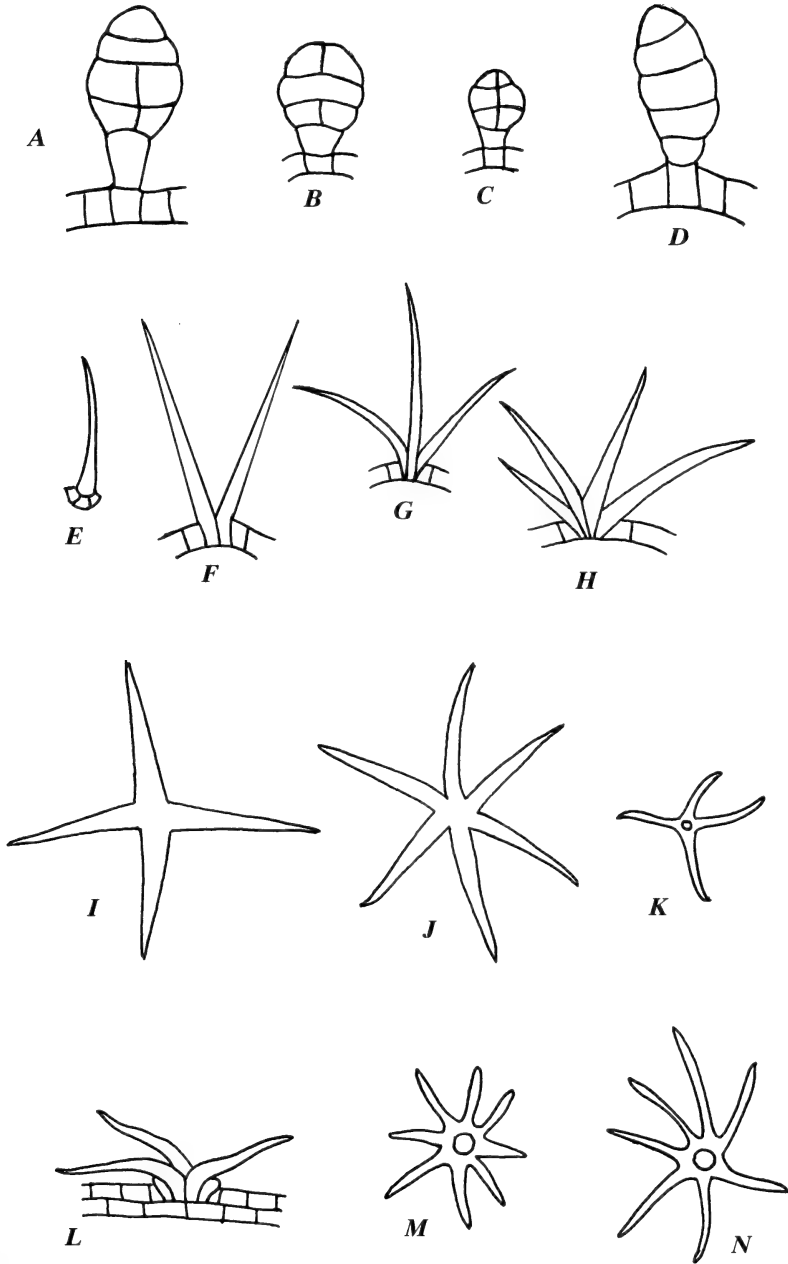


Figure 1. Trichome types in *Grewia* and *Microcos*.

A, short unicellular stalk with multicellular elliptic glandular head; **B**, short unicellular stalk with multicellular broadly elliptic glandular head; **C**, short unicellular stalk with multicellular rounded glandular head; **D**, short unicellular stalk with multicellular oblong glandular head; **E**, simple; **F**, 2-armed tufted; **G**, 3-armed tufted; **H**, 4-armed tufted; **I**, 4-armed stellate; **J**, 6-armed stellate; **K**, 4-armed cushioned stellate; **L**, 4-armed cushioned stellate; **M**, 8-armed cushioned stellate; and **N**, 7-armed cushioned stellate trichomes.

Table 1. Leaf epidermal characters in *Grewia* and *Microcos*

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>Grewia</i>																	
<i>occidentalis</i> (type species)	sc	sc	st	a	e/b	s	a	d	-	-	-	-	+	-	+	+	s
<i>hulperakensis</i>	sc	sc	st	a	e/b	s	h	d	+	++	+	+++	-	-	++	++	s
<i>laevigata</i>	sc	sc	st	a	e/b	s	h	d	+/-	+/-	+++	-	+/+	++/+	+	+	s/l
<i>multiflora</i>	sc	sc	st	a	b	s	h	d	+/-	++	+++	-	-	-	+	+	s
<i>polygama</i>	sc	sc	st	a	b	r	a	d	+/-	++/+	+	-	-	++/+	+	++	s
<i>Microcos</i>																	
<i>paniculata</i> (type species)	u	sc	st	p/n	b/r/o	r	h	d	-	-/+	-	-	++	++	+	+	l
<i>antidesmifolia</i> var. <i>antidesmifolia</i>	sc	sc	-	p/n	b/r/o	s	h	d	-	-	-	-	-	-	+	+	l
<i>antidesmifolia</i> var. <i>hirsuta</i>	sc	sc	-	p/n	b/r/o	s	a	d	-/+	++	+	+/+	-	++	+	+	l
<i>borneensis</i>	sc	sc	-	p/n	b/r/o	s	h	d	-	-/+	-	-	-	+	-/+	-	s
<i>cinnamomifolia</i>	sc	sc	-	p/n	b/r/o	s	h	d	-	-/+	-	-	-	+	+	+	l
<i>crassifolia</i>	sc	u	-	p/n	b/r/o	s	h	d	-	-	-	-	-	+	+	+	l
<i>dulienis</i>	u	u	-	p/n	b/r/o	r	h	d	-/+	++	+	++	-	-	+	+	l
<i>erythrocarpa</i>	sc	sc	-	p/n	b/r/o	s	h	d	-/+	+++	++	+/+	-	-	++	++	l
<i>fibrocarpa</i>	u	sc	-	p/n	b/r/o	s	h	d	+++	+++	+++	++/+	-	-	+	+	l
<i>globulifera</i>	sc	sc	-	p/n	b/r/o	s	h	g	+	++	+++	++/+	-	-	+	++	l
<i>gracilis</i>	u	u	-	p/n	b/r/o	s	a	d	+	++	+	-	-	++	+	+	l
<i>henrici</i> var. <i>acuta</i>	sc	sc	-	p/n	b/r/o	s	h	d	-/+	-/+	+	-	-	+++	+	++	l
<i>hirsuta</i>	sc	sc	-	p/n	b/r/o	s	h	d	-/+	++	+++	-	-	++/+	+	+	l
<i>kinabaluensis</i>	sc	sc	-	p/n	b/r/o	s	h	g	-	-	-	-	-	+++	-	-	l
<i>lanceolata</i>	sc	sc	-	p/n	b/r/o	s	h	d	-/+	-/+	-	-	-	+++	+	+	l
<i>latifolia</i>	sc	u	-	p/n	b/r/o	s	a	d	++	-/+	+++	++	-	+++	+	+	l
<i>latisipulata</i> var. <i>latisipulata</i>	sc	sc	-	p/n	b/r/o	s	h	d	-	-	-	-	-	-	+	+	l
<i>laurifolia</i>	sc	sc	-	p/n	b/r/o	s	h	d	-/+	++	-	-	-	+++	+	+	l
<i>malayana</i>	u	u	-	p/n	b/r/o	r	h	d	-/+	++	+++	++	-	+++	+	+	l
<i>membranifolia</i>	sc	sc	-	p/n	b/r/o	s	h	d	-/+	-/+	+++	++	-	+++	-/+	+	l
<i>opaca</i>	sc	u	-	p/n	b/r/o	s	h	d	-/+	-/+	+++	+/+	-	+++	+	+	l
<i>ossca</i>	sc	sc	-	p/n	b/r/o	s	h	d	-	-/+	++	-	+++	-	+	+	s
<i>pachyphylla</i>	sc	u	-	p/n	b/r/o	s	h	g	-	-	-	-	-	-	+	+	l
<i>pearsonii</i>	u	u	-	p/n	b/r/o	s	h	d	-/+	+++	-	-	+++	-	++	+	l
<i>phaneroneura</i>	sc	u	-	p/n	b/r/o	r	h	d	++	+++	+++	-	++	++/+	+	+	l
<i>reticulata</i>	u	u	-	p/n	b/r/o	s	h	d	++	+++	++	+/+	-	++	++	++	l
<i>riparia</i>	sc	sc	-	p/n	b/r/o	s	h	g	+	++	+	-	-	+++	+	+	l
<i>stylocarpioides</i>	sc	sc	-	p/n	b/r	s	h	d	-/+	-/+	-	-	-	+++	+	+	l
<i>subcordifolia</i>	sc	sc	-	p/n	b/r/o	s	h	d	+	++	++	-	-	+++	+	+	l
<i>subpepata</i>	sc	sc	-	p/n	b/r/o	s	a	g	+	++	-	-	-	+++	++	++	l
<i>samantrana</i>	u	u	-	p/n	b/r/o	s	a	d	+	++	-	-	-	+++	++	++	l

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>Microcos</i>																	
<i>tomentosa</i>	sc	sc	st	p/n	b/r/o	r	a	g	-/+	+++	-	-	-	+++	++	++	1
<i>triflora</i> var. <i>triflora</i>	sc	sc	-	p/n	b/r/o	s	h	d	-	-	-	-	-	-	-	-	s
<i>triflora</i> var. <i>longipetiolata</i>	sc	sc	-	p/n	b/r/o	s	h	d	-	-	-	-	-	-	-	+	1

Legend: / = or; + = present; - = absent; +++ = dense; ++ = moderately dense; + sparse; - = absent.

Columns:

1. Sinuosity of anticlinal cell wall of adaxial epidermis (u = undulate; sc = straight or curved)
2. Sinuosity of anticlinal cell wall of abaxial epidermis
3. Radiating cuticular striation (st = striated)
4. Predominant type of stomata on abaxial epidermis (a = anomocytic; n = anisocytic; p = paracytic)
5. Shape of stomata in outline (e = elliptic; b = broadly elliptic; r = rounded; o = oblate)
6. Elevation of stomata in relation to epidermis (s = same level; r = raised)
7. Stomatal distribution (h = hypostomatous; e = epistomatous; a = amphistomatous)
8. Pattern of stomatal distribution (d = random; g = regular)
9. Occurrence of non-glandular trichome on the adaxial epidermis
10. Occurrence of non-glandular trichome on the abaxial epidermis
11. Frequency of simple trichomes
12. Frequency of tufted trichomes
13. Frequency of stellate trichomes
14. Frequency of cushioned stellate trichomes
15. Occurrence of glandular trichome on the adaxial epidermis
16. Occurrence of glandular trichome on the abaxial epidermis
17. Body/stalk of glandular trichome (s = sessile; l = short unicellular).

Micrographs were made of both trichomes and stomata.

The pattern of stomatal distribution was classified as random (i.e., low density of stomata distributed randomly without regular pattern) or regular (i.e., high density of stomata in a regular pattern). Stomatal sizes were measured directly using a calibrated linear eyepiece micrometer. Density mm^{-2} was counted from 25 unit areas on the abaxial surface and stomatal index was determined using the formula adapted from Wilkinson (1979: 114). Trichomes were observed in epidermal peels as well as stereoscopic observations of herbarium specimens. The descriptive terminology of epidermal features is based on Van Cotthem (1970); Radford *et al.* (1974); Wilkinson (1979); Theobald *et al.* (1979) and Baranova (1987). Trichome types are illustrated in Fig. 1 and leaf epidermal characters are summarised in Table 1.

Results

GREWIA L.

(Figure 1; Plates 1 and 2; Table 1)

Stomatal Complex

Epidermal and subsidiary cells

In the species investigated, the anticlinal walls of the epidermal cells on both the leaf adaxial and abaxial surfaces are straight. This particular character, therefore, has no taxonomic value for distinguishing *Grewia* species.

Cuticular striation occurs only on the epidermal cells adjacent to the stomata. The striae radiating from the external edges of guard cells are either long (*G. occidentalis*, *G. huluperakensis* and *G. multiflora*) or, less frequently, short (*G. laevigata* and *G. polygama*).

Stomata

The stomata are mostly surrounded by a limited number of unspecialised cells that are indistinguishable in size and shape from the epidermal cells. However, a few stomata are occasionally accompanied on either side by one or more subsidiary cells parallel to the long axis of the pore and guard cells. Hence, the majority of the stomata are anomocytic or very rarely anisocytic and paracytic types.

The stomatal outline varies from elliptic, broadly elliptic to rarely rounded (*G. huluperakensis* and *G. laevigata*) to exclusively broadly elliptic (*G. multiflora*) or broadly elliptic to rarely rounded (*G. polygama*). The stomata are elevated slightly above the surrounding epidermal cells in *G. polygama*, but positioned at the same level in the other three species.

The stomata are 15–27.2 μm long and 12–22.4 μm wide with a mean length of 18.6 μm in *G. polygama*, 19.5–19.8 μm in *G. huluperakensis* and *G. multiflora*, and 22.9 μm in *G. laevigata*. Mean width ranges from 14.4–15.2 μm in *G. huluperakensis*, *G. multiflora* and *G. polygama* to 17 μm in *G. laevigata*. The range of length-width ratios (L/W) is (1–)1.2–1.4(–1.7).

Stomata distribution

Leaves are either hypostomatous (with stomata restricted to the abaxial surface) in *G. huluperakensis*, *G. laevigata* and *G. multiflora* or amphistomatous (stomata on both sides) in *G. polygama*. In all four species, the stomata are randomly distributed.

The stomatal density ranges from 80 to 180 mm^{-2} , with means ranging from 95 to 157 mm^{-2} . In *G. laevigata*, the stomatal density, (80–)95(–120), is slightly lower than that of *G. huluperakensis*, *G. multiflora* and *G. polygama*, (136–)147–157(–180). Stomatal index ranges between 11.3 and 29, with a mean of 14.1 in *G. laevigata* and 25.9–27.3 in *G. huluperakensis*, *G. multiflora* and *G. polygama*.

Trichomes

Non-glandular trichomes

On the adaxial leaf surface, non-glandular trichomes are sparse in *G. huluperakensis*, and sparse to none in *G. laevigata*, *G. multiflora* and *G. polygama*. On the abaxial surface, dense to moderately dense non-glandular trichomes occur in *G. polygama*, and sparse to none in *G. laevigata*. In *G. huluperakensis* and *G. multiflora*, the abaxial surface is moderately densely covered with non-glandular trichomes.

In *Grewia*, four main types and nine subtypes of non-glandular trichomes are recognised (Fig. 1). These are: (i) simple trichomes, which are long and tapered at the tip; (ii) tufted trichomes, which are either 2-, 3- or 4-armed; (iii) stellate trichomes, which are either 4-, 5- or 6-armed and without a central cushion; and (iv) cushioned stellate trichomes, which are 4–8-armed and with a central cushion. The cushioned stellate trichomes are formed by a multicellular hair base (Figure 1L).

These were observed on either the abaxial, adaxial, or both sides of the leaf (Table 1). Simple trichomes are present in *G. huluperakensis* (sparse), *G. multiflora* (dense) and *G. polygama* (sparse), but absent in *G. laevigata*. The 2–4-tufted non-glandular trichomes are dense in *G. huluperakensis*, but are absent in the other species. Four-armed stellate trichomes are sparsely present in *G. occidentalis* (the type species) but absent in the other species, while the 5–6-armed stellate trichomes are present in *G. laevigata* but absent in the others. The 4–8-armed cushioned stellate non-glandular trichomes occur in *G. laevigata* and *G. polygama*,

but are absent in the other species .

Glandular trichomes

Glandular trichomes are present on both leaf surfaces, varying from sparse to moderately dense. Each glandular trichome consists of a multicellular head which is either sessile or with a short unicellular stalk. The outline of the multicellular head can be elliptic as in *G. huluperakensis* and *G. multiflora*, or broadly elliptic as in *G. huluperakensis*, *G. laevigata* and *G. multiflora*, or rounded as in *G. laevigata*, or oblong as in *G. polygama*. All *Grewia* species examined possess glandular trichomes with short unicellular stalks, except *G. laevigata* which has sessile or short-stalked glandular trichomes.

Remarks

Apart from minor differences, the stomatal characters and trichome micromorphology of these species conform to those of *G. occidentalis* (the type species of the genus *Grewia*).

The leaves of *G. occidentalis* are glabrous on both surfaces except the midrib and secondary veins, which are sparsely covered with 4–6-armed stellate trichomes.

Based on trichome micromorphology, the four species can be segregated into three broad groups as follows:

- Group 1. *G. multiflora*: Simple non-glandular trichomes only
- Group 2. *G. huluperakensis*: Simple and tufted 2–4-armed non-glandular trichomes
- Group 3. *G. laevigata* and *G. polygama*: 4–8-armed stellate and/or cushioned stellate trichomes.

This study mostly confirms earlier investigations (Metcalf and Chalk, 1950; Inamdar *et al.*, 1983; Rao and Ramayya, 1987; Rao, 1990; Sharma, 1990), but with some differences. In *G. polygama* from India, Sharma (1990) observed trichomes with short basal cell, peltate apical cell and 5–10-armed tufted trichomes, but these types were not observed in *G. polygama* from Peninsular Malaysia. This is probably the same as 4–8-armed stellate trichomes as defined by the author. Similarly, Rao also reported simple unicellular and 5–10-armed tufted trichomes in *G. glabra* Blume (now *G. multiflora*). In the present study, only the simple trichomes were observed in Bornean material. The simple unicellular filiform trichomes commonly found by Inamdar *et al.* (1983) in the vegetative and floral parts of *G. asiatica* L. were not observed in the Peninsular Malaysian and Bornean *Grewia* species. Similarly, mucilaginous cells observed by Rao and Ramayya (1984) in the adaxial surface of *G. subinaequalis* DC. and *G. tenax* (Forsk.) Aschers. & Schwf. were not encountered in any

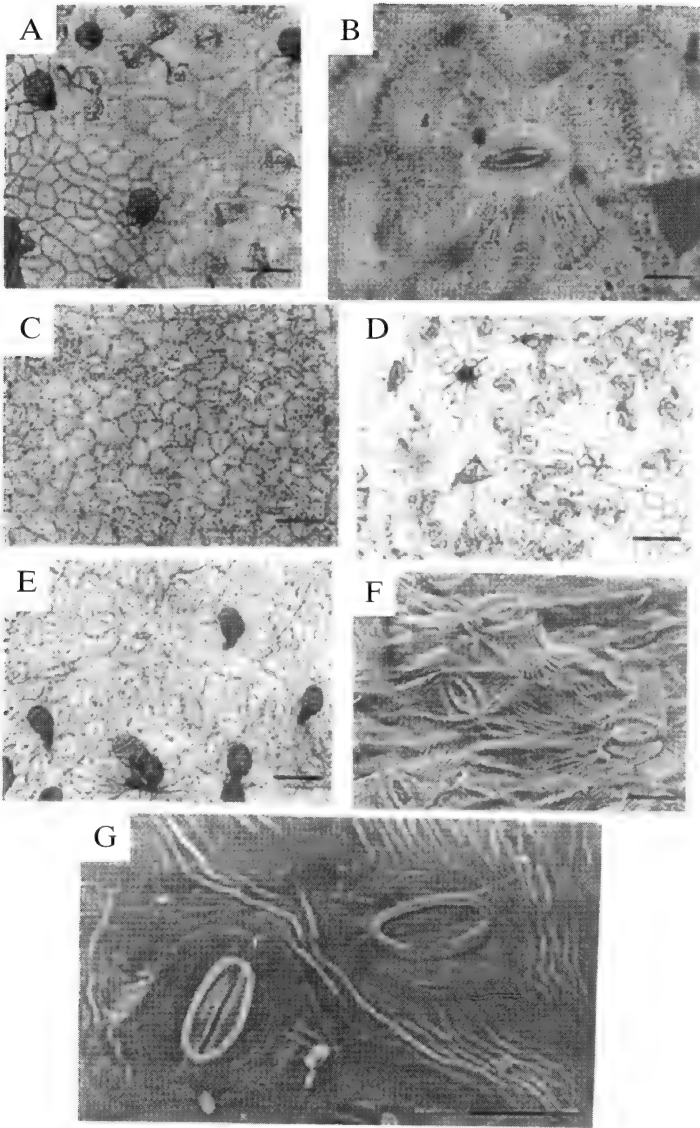


Plate 1. Stomatal complex of *Grewia* species

A: *G. laevigata* (Abdul Samat 265), LMs of abaxial leaf surface showing straight anticlinal wall of epidermal cells. — **B:** *G. occidentalis* (type species, Relinhood 483), LMs of abaxial leaf surface with stomata showing stomatal type, stomatal shape in outline, and orientation of striae over epidermal cells. — **C–F:** LMs (C–E) and SEMs (F) of abaxial leaf surface showing stomatal distribution. **C:** *G. occidentalis* (Relinhood 483); **D:** *G. laevigata* (Abdul Samat 265); **E:** *G. huluperakensis* (Turner 94–94); **F:** *G. multiflora* (Motley 240). — **G:** *G. huluperakensis* (Burkill & Mohd. Haniff SFN 12410), SEMs of abaxial leaf surface with stomata showing orientation of striae over anomocytic epidermal cells. — Bar equals 10 μm in B, F–G; 50 μm in A, C–E.

Peninsular Malaysian and Bornean material.

MICROCOS L.

(Figure 1; Plates 3 and 4; Table 1)

Stomatal Complex

Epidermal and subsidiary cells

In most species of *Microcos* investigated, the anticlinal walls of the epidermal cells on the adaxial surface of the leaf are straight or curved. In *M. dulitensis*, *M. fibrocarpa*, *M. gracilis*, *M. malayana*, *M. pearsonii*, *M. reticulata*, and *M. sumatrana*, however, these cell walls are usually undulate. On the abaxial surface, the anticlinal epidermal cell walls are straight to curved as in *M. antidesmifolia* (var. *antidesmifolia* and var. *hirsuta*), *M. borneensis*, *M. cinnamomifolia*, *M. erythrocarpa*, *M. fibrocarpa*, *M. globulifera*, *M. henrici* var. *acuta*, *M. kinabaluensis*, *M. lanceolata*, *M. latistipulata* var. *latistipulata*, *M. laurifolia*, *M. membranifolia*, *M. ossea*, *M. riparia*, *M. stylocarpoides*, *M. subepetala*, *M. tomentosa*, and *M. triflora* (var. *triflora* and var. *longipetiolata*), or undulate as in *M. crassifolia*, *M. dulitensis*, *M. gracilis*, *M. hirsuta*, *M. latifolia*, *M. malayana*, *M. opaca*, *M. pachyphylla*, *M. pearsonii*, *M. phaneroneura*, *M. reticulata*, *M. subcordifolia*, and *M. sumatrana*. Cuticular striation of epidermal or subsidiary cells is absent in most species, but short striae are frequently present in *M. tomentosa*.

Stomata

Stomata of *Microcos* species found in Peninsular Malaysia and Borneo are mainly paracytic and anisocytic or occasionally anomocytic. The outline of the stomata varies from broadly elliptic, rounded to oblate in most species of *Microcos* but broadly elliptic to rounded in *M. stylocarpoides*.

Stomatal size varies from 10 x 9 µm to 18 x 18 µm. Mean stomatal length ranges from 12 µm in *M. pearsonii* to 16.4 µm in *M. dulitensis*, and width from 12 µm in *M. subcordifolia* to 16.1 µm in *M. borneensis*. The stomatal length-width ratios (L/W) range from 0.8 to 1.5 with mean length-width ratios of 0.9 in *M. kinabaluensis*, *M. malayana* and *M. tomentosa*, 1.1 in *M. antidesmifolia* var. *hirsuta*, *M. fibrocarpa*, *M. globulifera*, *M. gracilis*, *M. hirsuta*, *M. phaneroneura*, *M. riparia*, *M. stylocarpoides*, *M. subepetala*, and *M. triflora* var. *triflora*, and equal to 1 in the other species.

In *M. dulitensis*, *M. malayana*, *M. phaneroneura*, and *M. tomentosa*, the stomata are raised above the level of the epidermal cells, but in the other species the stomata are at the same level with the epidermal cells.

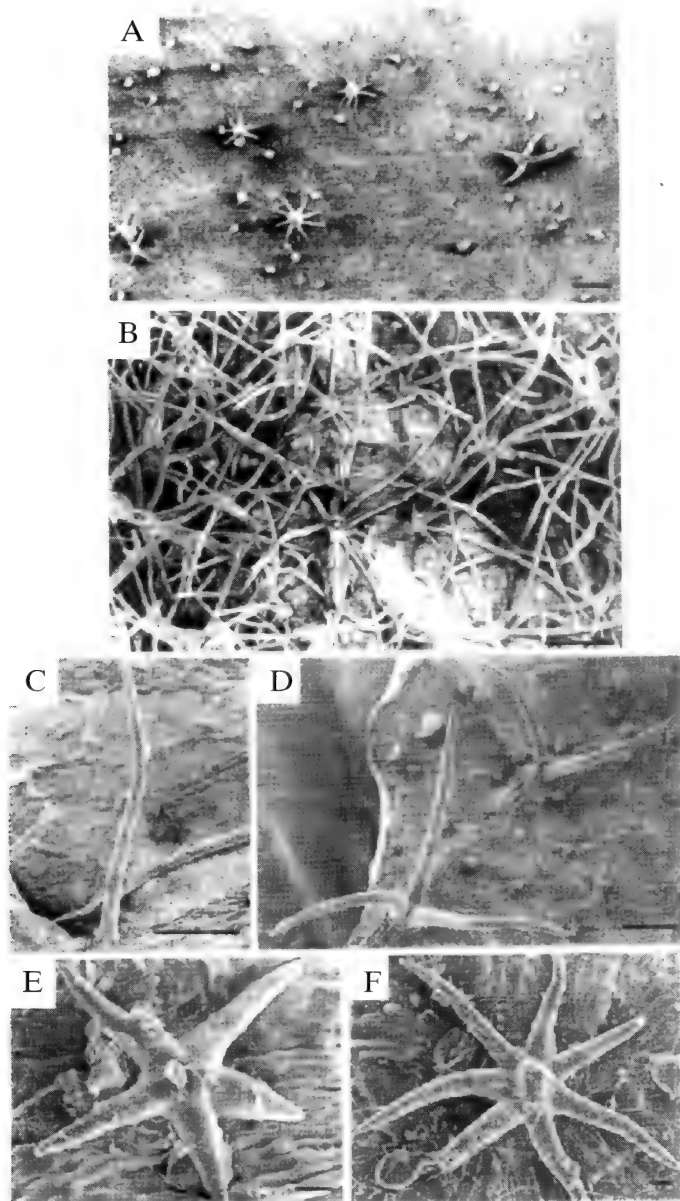


Plate 2. Non-glandular trichomes of *Grewia* species.

A–B: SEMs of abaxial leaf surface showing non-glandular trichomes distribution, **A:** *G. laevigata* (Asik SAN 113171), sparse; **B:** *G. polygama* (Soepadmo & Mahmud ES 1219), dense. — **C–F:** SEMs of abaxial leaf surface showing main types and subtypes of non-glandular trichomes. **C:** *G. multiflora* (Motley 240), simple trichomes; **D:** *G. huluperakensis* (Burkill & Md. Haniff SFN 12410), tufted trichomes of 2- or 3- armed form; **E:** *G. laevigata* (Mohd. Nur SFN 32966), 5-armed stellate trichomes; **F:** *G. laevigata* (Aban SAN 49197), cushioned stellate trichomes of 7-armed form. — Bar equals 10 μm in E–F; 100 μm in A–D.

Stomatal distribution

In *M. antidesmifolia* var. *hirsuta*, *M. gracilis*, *M. latifolia*, *M. subpetala*, *M. sumatrana*, and *M. tomentosa*, stomata occur on both surfaces of the leaf, but in the other species they are confined to the abaxial surface. The stomatal distribution pattern in *Microcos* varies from random to regular. The random distribution pattern is predominant in *Microcos* species, while the regular type occurs in only a few species, such as *M. globulifera*, *M. kinabaluensis*, *M. pachyphylla*, *M. riparia*, *M. subpetala*, and *M. tomentosa*.

The stomatal density varies from 84 mm⁻² in *M. malayana* to 316 mm⁻² in *M. riparia*, while the mean stomatal density ranges from 92 mm⁻² in *M. malayana* to 291 mm⁻² in *M. globulifera* and *M. riparia*. The stomatal index ranges from 15.5 in *M. borneensis* to 30.6 in *M. pearsonii*, while the mean stomatal index ranges from 17 in *M. opaca* to 28.4 in *M. globulifera*.

Trichomes

Non-glandular trichomes

Non-glandular trichomes are absent on both the adaxial and abaxial leaf surfaces (including the midrib and veins) of *M. antidesmifolia* var. *antidesmifolia*, *M. crassifolia*, *M. kinabaluensis*, *M. latistipulata* var. *latistipulata*, *M. pachyphylla*, and *M. triflora* (var. *triflora* and var. *longipetiolata*).

On the adaxial leaf surface, non-glandular trichomes are moderately dense in *M. latifolia*, *M. phaneroneura* and *M. reticulata*, sparse in *M. fibrocarpa*, *M. globulifera*, *M. gracilis*, *M. subcordifolia*, and sparse or absent in *M. lanceolata* and *M. tomentosa*. In *M. antidesmifolia* var. *hirsuta*, *M. dulitensis*, *M. erythrocarpa*, *M. henrici* var. *acuta*, *M. hirsuta*, *M. laurifolia*, *M. malayana*, *M. membranifolia*, *M. opaca*, *M. pearsonii*, and *M. stylocarpoides*, the adaxial side of the lamina is glabrous, but the midrib and secondary veins are sparsely to densely covered with non-glandular trichomes.

On the abaxial leaf surface, non-glandular trichomes are dense in *M. fibrocarpa*, *M. phaneroneura*, *M. reticulata*, and *M. tomentosa*, moderately dense in *M. antidesmifolia* var. *hirsuta*, *M. dulitensis*, *M. globulifera*, *M. gracilis*, *M. hirsuta*, *M. malayana*, *M. subcordifolia*, and *M. sumatrana*, and sparse to none in *M. henrici* var. *acuta*, *M. lanceolata*, *M. membranifolia*, *M. riparia*, and *M. stylocarpoides*. In *M. borneensis*, *M. cinnamomifolia*, *M. erythrocarpa*, *M. latifolia*, *M. laurifolia*, *M. ossea*, *M. pearsonii*, and *M. subpetala*, the abaxial surface of the lamina is glabrous, but non-glandular trichomes are present on the midrib and/or secondary veins.

As in *Grewia*, four main types of non-glandular trichomes were observed in *Microcos*, i.e. simple, tufted, stellate, and cushioned stellate trichomes. The leaf surface of *M. dulitensis*, *M. erythrocarpa*, *M. fibrocarpa*,

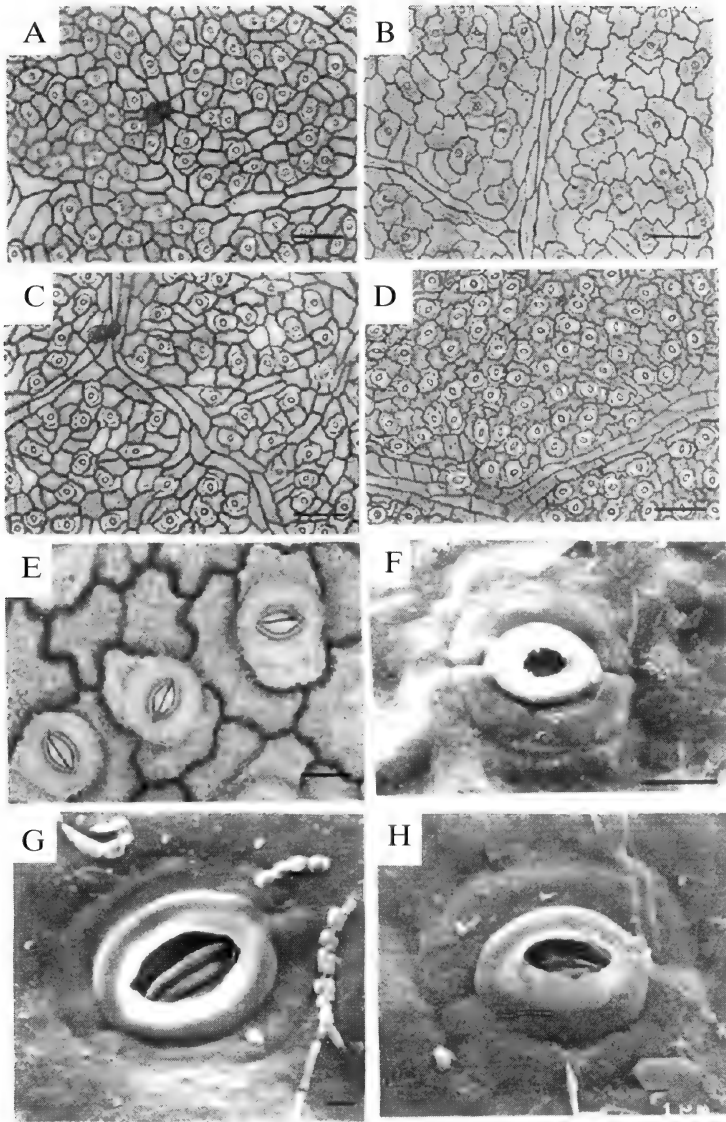


Plate 3. Stomatal complex of *Microcos* species.

A–B: LMs of abaxial leaf surface showing straight or curved (A) and undulate (B) anticlinal wall of epidermal cells. **A:** *M. antidesmifolia* var. *antidesmifolia* (Stone & Chin 13853); **B:** *M. malayana* (Whitmore FRI 15328). — **C–D:** LMs of abaxial leaf surface showing stomatal distribution. **C:** *M. lanceolata* (Kochummen KEP 79086), random; **D:** *M. pachyphylla* (Elmer 21704), regular. — **E:** *M. dulitensis* (Pickles S. 3689). LMs of abaxial leaf surface with stomata showing stomatal type and stomatal shape in outline. — **F–H:** SEMs of abaxial leaf surface with stomata showing variation in elevation of the guard cells relative to epidermal cells (F–G: same level; H: raised). **F:** *M. ossea* (Tong S. 33866); **G:** *M. antidesmifolia* var. *hirsuta* (Scortechini s.n.); **H:** *M. malayana* (Chelliah KEP 104372). — Bar equals 1 μm in G–H; 5 μm in F; 10 μm in E; 50 μm in A–D.

M. globulifera, *M. latifolia*, *M. malayana*, and *M. opaca* is covered with simple and 2–4-armed tufted trichomes, whereas that of *M. antidesmifolia* var. *hirsuta* and *M. reticulata* is covered with simple, 2–4-armed tufted trichomes and 4–8-armed cushioned stellate trichomes.

A combination of simple and 4–8-armed cushioned stellate trichomes is found in *M. henrici* var. *acuta*, *M. hirsuta*, *M. membranifolia*, and *M. subcordifolia*, while a combination of simple, 4–7-armed cushioned stellate and 4-armed stellate trichomes is observed in *M. phaneroneura*. The midrib and secondary veins of *M. ossea* on the abaxial surface bear simple and 5-armed stellate trichomes, while those of *M. pearsonii* possess dense 5-armed stellate trichomes. *Microcos borneensis*, *M. cinnamomifolia*, *M. gracilis*, *M. lanceolata*, *M. laurifolia*, *M. riparia*, *M. stylocarpoides*, *M. subepetala*, *M. sumatrana*, and *M. tomentosa*, on the other hand, have 4–8-armed cushioned stellate trichomes on the lamina or on the midrib and secondary veins.

Glandular trichomes

In most species (except *M. kinabaluensis*, which has completely glabrous leaves), glandular trichomes of varying density are found on both leaf surfaces. In *M. borneensis* and *M. membranifolia*, glandular trichomes are in clusters of 2–4.

The glandular trichomes of most *Microcos* species investigated possess short unicellular stalks, except in *M. borneensis*, *M. ossea* and *M. triflora* var. *triflora* where the glandular trichomes are sessile. The outline of the multicellular head varies from elliptic (*M. crassifolia*, *M. henrici* var. *acuta*, *M. lanceolata*, *M. pachyphylla*, *M. pearsonii*, *M. riparia*, and *M. tomentosa*) to broadly elliptic (*M. dulitensis*, *M. erythrocarpa*, *M. gracilis*, *M. latistipulata* var. *latistipulata*, *M. laurifolia*, *M. malayana*, *M. opaca*, *M. ossea*, *M. phaneroneura*, *M. stylocarpoides*, and *M. subcordifolia*), rounded (*M. globulifera*, *M. hirsuta*, *M. membranifolia*, and *M. reticulata*), or oblong (*M. latifolia* and *M. triflora* var. *triflora*) or varying from broadly elliptic to rounded in *M. antidesmifolia* var. *antidesmifolia* and var. *hirsuta*, *M. cinnamomifolia*, *M. fibrocarpa*, *M. subepetala*, and *M. triflora* var. *longipetiolata*, or rounded to oblong in *M. borneensis* and *M. sumatrana*.

Remarks

The characters of the stomatal complex in the species examined match those of *M. paniculata* (the type species of the genus *Microcos*), except in the absence of cuticular striation on the epidermal cells in most of the Peninsular Malaysian and Bornean species.

In trichome micromorphology, they also match well with *M. paniculata*. The leaves of *M. paniculata* are glabrous on both surfaces,

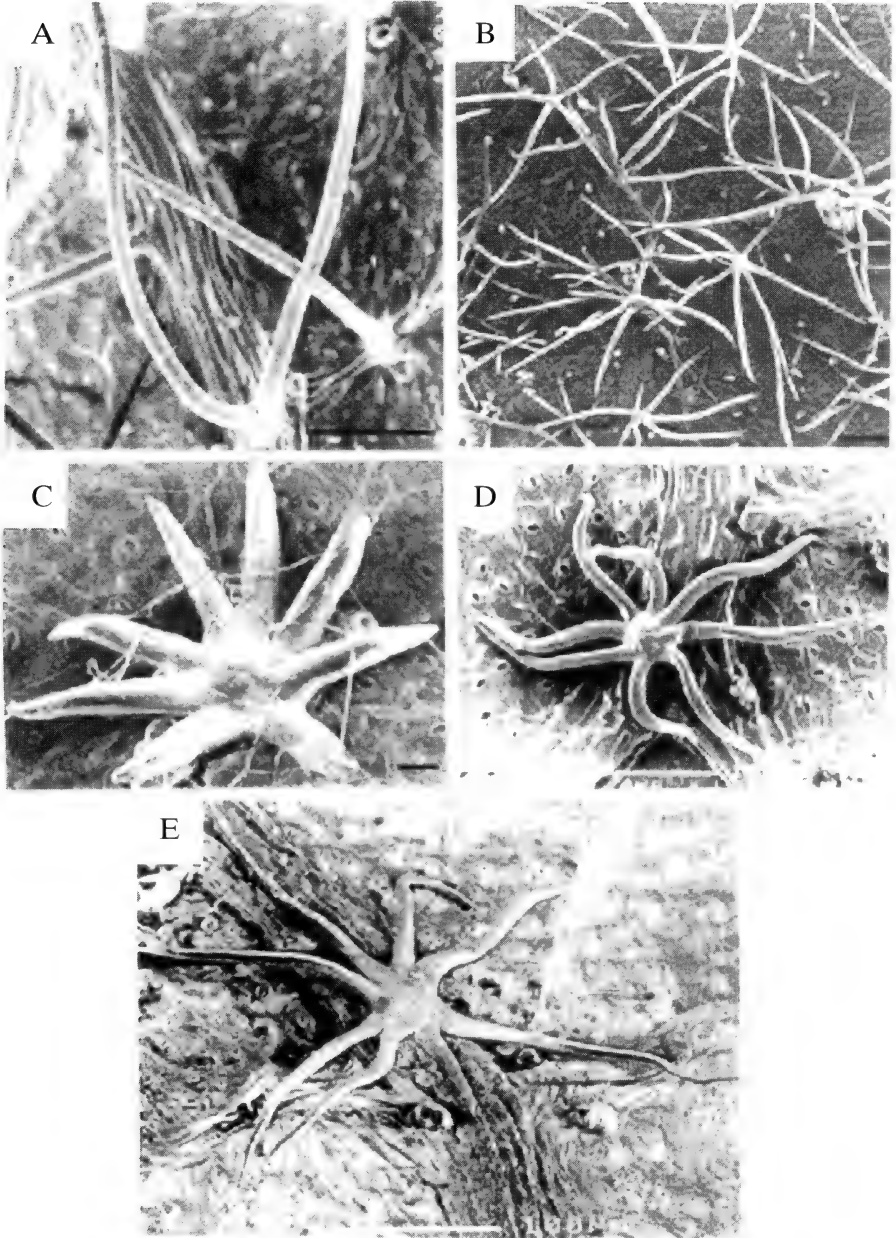


Plate 4. Non-glandular trichomes of *Microcos* species.

A: *M. fibrocarpa* (Lesmy FRI 33964), simple trichomes and 2-armed tufted trichomes. — **B:** *M. tomentosa* (Spare SFN 36245), SEMs of abaxial leaf surface showing dense non-glandular trichomes distribution. — **C:** *M. henrici* var. *acuta* (Ilias S. 36520), 8-armed cushioned stellate trichomes. — **D:** *M. paniculata* (type species, Cramer 3405), 8-armed cushioned stellate trichomes. — **E:** *M. paniculata* (Clemens 4122), 8-armed stellate trichomes. — Bar equals 100 μ m in A–E.

except the midrib and secondary veins in the abaxial surface which are sparsely covered with 8-armed stellate and cushioned stellate trichomes.

Based on trichome micromorphology, the Peninsular Malaysian and Bornean species of *Microcos* can be separated into five broad groups:

- Group 1. *M. kinabaluensis*: Glandular and non-glandular trichomes absent.
- Group 2. *M. antidesmifolia* var. *antidesmifolia*, *M. crassifolia*, *M. latistipulata* var. *latistipulata*, *M. pachyphylla*, *M. triflora* (var. *triflora* and var. *longipetiolata*): Glandular trichomes present; non-glandular trichomes absent.
- Group 3. *M. antidesmifolia* var. *hirsuta*, *M. dulitensis*, *M. erythrocarpa*, *M. fibrocarpa*, *M. globulifera*, *M. henrici* var. *acuta*, *M. hirsuta*, *M. latifolia*, *M. malayana*, *M. membranifolia*, *M. opaca*, *M. ossea*, *M. phaneroneura*, *M. reticulata*, and *M. subcordifolia*: Glandular and non-glandular trichomes of simple, tufted, stellate and cushioned stellate hairs present.
- Group 4. *M. pearsonii*: Glandular and non-glandular trichomes of stellate hairs present.
- Group 5. *M. borneensis*, *M. cinnamomifolia*, *M. gracilis*, *M. lanceolata*, *M. laurifolia*, *M. riparia*, *M. stylocarpoides*, *M. subpetala*, *M. sumatrana*, and *M. tomentosa*: Glandular and non-glandular of cushioned stellate trichomes present.

Results of previous studies on the trichomes of *Microcos* (Inamdar *et al.*, 1983; Sharma, 1990) differ slightly from those of the present study. Sharma (1990) reported the occurrence of 5–10-armed tufted stellate trichomes and three-celled unequally 2-armed trichomes with short stalks in *G. microcos* L. (now *M. paniculata*). These two types of trichomes, however, were not observed in any species investigated in the present study.

Discussion

Comparative stomatal complex characters of Grewia and Microcos

The differences between the leaf epidermal characters of *Grewia* and *Microcos* species occurring in Peninsular Malaysia and Borneo are summarised in Table 2. In *Grewia*, the anomocytic stomata are the predominant type, whereas in *Microcos* the paracytic and anisocytic stomata are the prevalent type. Radiating cuticular striation is present on the epidermal cells immediately adjacent to the guard cells in *Grewia* species, but absent on the subsidiary cells or epidermal cells adjacent to the guard cells in *Microcos* species, except in *M. tomentosa*. The stomatal outline in

Grewia species is mainly elliptic to broadly elliptic with average L/W ratios of 1.2–1.4, whereas in *Microcos* species it is mostly broadly elliptic, rounded to oblate with average L/W ratios of 0.9–1.1.

The leaves of *Grewia* species are either amphistomatic, e.g. *G. occidentalis*, *G. polygama*, and *G. subinaequalis* DC. (Rao and Ramayya, 1981), or hypostomatic, e.g. *G. huluperakensis*, *G. laevigata* Vahl, *G. multiflora*, and *G. tenax* (Forsk.) Aschers. & Schwf. (Rao and Ramayya, 1981). Likewise, the leaves of *Microcos* species may be amphistomatic (*M. antidesmifolia* var. *hirsuta*, *M. gracilis*, *M. latifolia*, *M. subpetala*, *M. sumatrana*, and *M. tomentosa*), or hypostomatic (*M. paniculata* and other species from Peninsular Malaysia and Borneo). In the Tiliaceae, amphistomatic leaves have been reported in a few species of *Corchorus* L. and *Triumfetta* L. (Rao and Ramayya, 1981; Singh and Dube, 1993). For related families in the Malvales, Rao and Ramayya (1981) reported exclusively amphistomatic leaves for Malvaceae, exclusively hypostomatic leaves for Elaeocarpaceae, and both amphistomatic and hypostomatic leaves for Bombacaceae and Sterculiaceae.

Table 2. Differences between the epidermal characters of *Grewia* and *Microcos* in Peninsular Malaysia and Borneo.

Genus Characters	<i>Grewia</i>	<i>Microcos</i>
Epidermal/Subsidiary cells		
Radiating cuticular striation	present	absent (except in <i>M. tomentosa</i>)
Stomata		
Type	predominantly anomocytic (occasionally paracytic and anisocytic)	mainly paracytic and anisocytic (occasionally anomocytic)
Outline	elliptic, broadly elliptic (occasionally rounded)	broadly elliptic, rounded, oblate
Average length (μm)	18.6–22.9	12–16.4
Average L/W ratio	1.2–1.4	0.9–1.1

Metcalfe and Chalk (1950) stated that in the Tiliaceae, the stomata were exclusively anomocytic (ranunculaceous), but Kundu and Sen (1958), Sen and Paul (1961), and Singh and Dube (1993) demonstrated the presence of anisocytic, paracytic and tetracytic stomata in Indian *Corchorus* species. Likewise, the present study also discovered that the stomata of *Grewia*

species in Peninsular Malaysia and Borneo were predominantly anomocytic and occasionally paracytic, and those of *Microcos* species were mainly paracytic and occasionally anomocytic. For other families in Malvales, Inamdar and Chohan (1969) reported the occurrence of anomocytic, anisocytic and paracytic stomata in the Bombacaceae (*Adansonia digitata* L. and *Bombax ceiba* Burm.f.) and the Malvaceae (*Althaea rosea* Cav.; *Gossypium herbaceum* L.; *Hisbiscus rosa-sinensis* L., *H. schizopetalus* Hook.f., *H. syriacus* L.; *Malvaviscus arboreus* Cav.; *Sida acuta* Burm.f., *S. alba* Cav.; and *Thespesia populnea* Sol. ex Corr.Serr.). Hussin and Sani (1998), on the other hand, reported that the stomata of 12 species of *Sterculia* L. (Sterculiaceae) were exclusively anomocytic.

The occurrence of different types of stomatal apparatus in the leaves of a single taxon or in different species of a genus or different genera of a family has been noted by many authors (Metcalf and Chalk, 1950; Kundu and Sen, 1958; Sen and Paul, 1961; Inamdar and Chohan, 1969; Rao and Ramayya, 1983; Singh and Dube, 1993), where usually a few stomata of one type occur along with the predominant stomata of another type. Less often, two or more stomatal types occur together as "codominants" on the same leaf and/or species, as for example in the Convolvulaceae (Pant and Banerji, 1965), and Bombacaceae, Sterculiaceae and Elaeocarpaceae (Rao and Ramayya, 1983).

Taxonomic value of trichome characters in Grewia and Microcos

The present study on the leaf trichomes of Peninsular Malaysian and Bornean *Grewia* and *Microcos* species reaffirms earlier observations on Tiliaceae species (Solereder, 1908; Metcalfe and Chalk, 1950; Tiwari, 1978; Rao and Ramayya, 1987; Sharma, 1990) as well as on related families of the order Malvales (Ramayya and Rao, 1976; Rao and Ramayya, 1977, 1983; Inamdar *et al.*, 1983; Salma, 1999), namely, the existence of several different trichomes types.

Based on the type, distribution and density of non-glandular trichomes, species of *Grewia* can be divided into three broad groups (i.e., non-glandular trichomes exclusively of simple hairs; non-glandular trichomes both simple and 2–4-armed tufted hairs; and 4–8-armed stellate and/or cushioned stellate trichomes). Likewise, five broad groups of species in *Microcos* can be recognised (i.e., glandular and non-glandular trichomes absent; glandular trichomes present but non-glandular trichomes absent; glandular and non-glandular trichomes of simple, tufted, stellate and cushioned stellate hairs present; glandular and non-glandular trichomes of stellate hairs present; and glandular and non-glandular cushioned stellate trichomes present).

The infraspecific variability may be due to genetic variability or ecological factors (Baas, 1975). In *M. triflora*, the two varieties differ in the the body/stalk of glandular trichomes (sessile in var. *triflora*; short unicellular in var. *longipetiolata*) and in *M. antidesmifolia*, the two varieties differ in the occurrence of non-glandular trichomes (absent in var. *antidesmifolia*; simple, tufted and cushioned stellate hairs in var. *hirsuta*). However, this infraspecific variation could not be correlated with ecological data, as information from the herbarium labels was insufficient.

Conclusions

On the basis of leaf epidermal characters, the genus *Microcos* in Peninsular Malaysia and Borneo can be distinguished from *Grewia* by a combination of the following characters: stomatal type, outline, mean length and L/W ratio, and the occurrence of cuticular striation on the epidermal cells immediately surrounding the guard cells. To some extent, this study supports Burret's view (1926) for segregating *Microcos* from *Grewia*. However, trichome micromorphological characters alone cannot be used for distinguishing genera, and species within each genus. According to the ordinal classification defined by APG (1998), stomatal types and trichomes are just minor variations on a pattern common to most Malvaceae, which now includes Tiliaceae.

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Appendix: Source of Materials Studied

The species and specimens studied are given below in alphabetical order; (1) = maceration only; (2) = trichomes only

Grewia occidentalis L. (type species): *Moss* 3959 (BM); *Relinhood* 483 (L); *Smook* 6553 (BM) — **G. huluperakensis** I.M.Turner: *Burkill & Md. Haniff SFN 12410* (SING); *Turner 94–94* (SING) — **G. laevigata** Vahl: *Aban SAN 49197* (SAN); *Abdul Samat 265* (KLU); *Amin & Joseph SAN 60068* (KEP); *Asik SAN 11317* (KEP, 2); *Mohd. Nur SFN 32966* (KEP) — **G. multiflora** Juss.: *Blume s.n.* (L sheet no. 908.253.1458; L); *Motley 240* (K) — **G. polygama** Roxb.: *Chin CSC 1832* (KEP, 2); *Chung RC 10* (KEP, 1); *Kamarudin & Mustapa FRI 42255* (KEP); *Kiah SFN 35286* (KEP); *Soepadmo & Mahmud ES 1219* (KEP).

Microcos paniculata L. (type species): *Bhargave 1787* (L); *Clemens 4122* (BM); *Cramer 3405* (L) — **M. antidesmifolia** (King) Burret **var. antidesmifolia**: *Everett FRI 14442* (KEP); *King's Collector 4085* (L); *Stone & Chin 13853* (KLU); **var. hirsuta** (King) Burret: *Creagh s.n.* (K); *Elmer 20911* (SING); *Enggoh FMS 48988* (KEP); *Scortechini s.n.* (BO) — **M. borneensis** Burret: *Ashton S. 17956* (KEP); *Smythies et al. S. 5877* (KEP) — **M. cinnamomifolia** Burret: *s.c. FMS 34460* (KEP); *Haviland 2256* (SAR); *Nicholson & Ping SAN 17701* (KEP) — **M. crassifolia** Burret: *Amin & Lideh SAN 70341* (KEP); *Amin et al. SAN 67317* (KEP, 1); *Ramos 1704* (K) — **M. dulitensis** Airy Shaw: *Pickles S. 3689* (SAR); *Richards 1767* (SING) — **M. erythrocarpa** (Ridl.) Airy Shaw: *Kochummen FRI 16417* (KEP); *Kochummen FRI 29363* (KEP) — **M. fibrocarpa** (Mast.) Burret: *Kiah SFN 35064* (KEP); *Lesmy FRI 33964* (KEP) — **M. globulifera** (Mast.) Burret: *Chan FRI 23806* (KEP); *Ogata KEP 105036* (KEP) — **M. gracilis** Stapf ex Ridl.: *Chai SAN 26066* (SAN); *Yü et al. S. 37752* (KEP) — **M. henrici** (Baker f.) Burret **var. acuta** R.C.K.Chung, (*ined.*): *Ilias S. 36520* (KEP); *Ilias S. 45121* (KEP); *Lai et al. S. 75359* (KEP) — **M. hirsuta** (Korth.) Burret: *Haviland 1471* (SING); *Korthals s.n.* (L sheet no. 944.56.122; L) — **M. kinabaluensis** R.C.K.Chung, (*ined.*): *Chew & Corner RSNB 4216* (SAN); *Chew & Corner RSNB 4994* (SAN) — **M. lanceolata** (Miq.) Burret: *Chelliah KEP 104621* (KEP); *Kochummen KEP 79086* (KEP) — **M. latifolia** Burret: *Whitmore FRI 8931*; *Wong WKM 1545* (SING) — **M. latistipulata** (Ridl.) Burret **var. latistipulata**: *Burkill SFN 7826* (SING); *Chai SAN*

29741 (KEP) — **M. laurifolia** (Hook. ex Mast.) Burret: *Kochummen FRI 16338* (KEP); *Razali 2809* (UKMB) — **M. malayana** R.C.K.Chung, (*ined.*); *Loh FRI 19249* (KEP); *Chelliah KEP 104372* (KEP); *Whitmore FRI 15328* (KEP) — **M. membranifolia** R.C.K.Chung, (*ined.*); *Kadir & Jiran SAN A 3367* (KEP); *Singh SAN 30672* (KEP) — **M. opaca** (Korth.) Burret: *Ilias S. 39135* (KEP); *Yii S. 41139* (KEP) — **M. ossea** Burret: *Clemens 21071* (SAR); *Dayang Awa & Ilias S. 45689* (KEP); *Tong S. 33866* (KEP) — **M. pachyphylla** Merr.: *Elmer 21704* (SING); *Salleh et al. BRUN 15315* (KEP) — **M. pearsonii** (Merr.) Burret: *Dewol & Donggop SAN 129474* (KEP); *Meijer & Pereira SAN 47225* (SAN) — **M. phaneroneura** Burret: *Chai S. 36100* (KEP); *Hallier 2868* (BO); *Ong OHC 716* (KEP, 1) — **M. reticulata** Ridl.: *Ashton S. 17800* (KEP); *Creagh s.n.* (K, 2); *Saikeh SAN 69284* (SAN, 2); *Wood SAN A 4788* (KEP) — **M. riparia** (Boerl. & Koord.) Burret: *Hallier 1314* (BO); *Yeob FMS 3190* (KEP) — **M. stylocarpoides** Burret: *Hallier 756* (BO); *Haviland 1685* (SAR) — **M. subcordifolia** R.C.K.Chung, (*ined.*); *Kirkup & Thomas DK 727* (KEP); *Niga NN 118* (KEP) — **M. subpetala** Stapf ex Ridl.: *Haviland 1885* (K) — **M. sumatrana** (Baker f.) Burret: *Forbes 2684* (L) — **M. tomentosa** Sm.: *Carrick 565* (KEP, 1); *Chung RC 9* (KEP); *Everett FRI 13785* (KEP); *Spare SFN 36245* (KEP); *Tachun FMS 23227* (KEP, 1) — **M. triflora** (Blanco) R.C.K.Chung **var. triflora**, (*ined.*); *Forestry Student PNH 35319* (KEP); *Lazo PNH 33406* (KEP); **var. longipetiolata** (Merr.) R.C.K.Chung, (*ined.*); *Aban & Soinin SAN 66898* (SAN); *Haviland 2332* (SAR, 1); *Wong WKM 1244* (KEP).

Updates on Sections of *Bulbophyllum* (Orchidaceae) Revised in Vermeulen (1993)

J.J. VERMEULEN

Singapore Botanic Gardens
Singapore 259569

Abstract

Some errors and omissions in the revision of *Bulbophyllum*, sections *Macrouris* and *Uncifera* (Vermeulen, 1993), are addressed.

Bulbophyllum sect. *Macrouris*

Bulbophyllum subpatulum* J.J. Verm., *nom. nov.

Bulbophyllum subpatulum J.J. Verm. — *Bulbophyllum muscicola* Schltr., Repert. Spec. Nov. Regni Veg., Beih. 1 (May 1st, 1913) 870; J.J. Verm., Orch. Mon. 7 (1993) 106. —TYPE: Papua New Guinea, Carr 10252 (neo SING, iso AMES, CANB, K, NY).

[Not *Bulbophyllum musciculum* Rchb.f., Flora 55 (1872) 275 (= close to *B. retusiusculum* Rchb.f., from continental South and East Asia.)]

[Not *Bulbophyllum muscicola* Schltr., Ann. Mus. Col. Marseille 3 (1913, exact date not traceable) 36 (= sect. *Trichopus*, from Madagascar)]

Notes: *Bulbophyllum musciculum* Rchb.f., a taxon overlooked by Vermeulen (1993), renders his attempts to properly date the original publications of both *B. muscicola* Schltr., both from 1913, superfluous. A new name for the New Guinea *B. muscicola* Schltr. is warranted, because *B. equivestigium* Gilli has to be deleted as a junior synonym, see under *B. cylindrobulbum*, below.

Bulbophyllum trifilum* J.J. Sm. subsp. *filisepalum* (J.J. Sm.) J.J. Verm., *comb. nov.

Bulbophyllum trifilum J.J. Sm. ssp. *filisepalum* (J.J. Sm.) J.J. Verm., Orch. Mon. 7 (1993) 117, *nom. inval.* — *Bulbophyllum filisepalum* J.J. Sm., Meded. Herb. Leiden 23 (1915) 15. —TYPE: Indonesia, Irian Jaya, Janowsky 412 (holo L, iso BO).

Notes: Paul Ormerod kindly informed me that the combination made in Vermeulen (1993) is invalid according to the International Code of Botanical Nomenclature (2000) Art. 33.5, because no reference is made to the original description of *B. filisepalum*. The error is corrected here.

Bulbophyllum* sect. *Uncifera

***Bulbophyllum cylindrobulbum* Schltr.**

Bulbophyllum cylindrobulbum Schltr. in Schum. & Laut., Nachtr. (1905) 200; J.J. Verm., Orch. Mon. 7 (1993) 178. —TYPE: Papua New Guinea, *Reeve 1015* (neo K, iso L).

Bulbophyllum equivestigium Gilli, Ann. Nat. Mus. Wien 84 (1983) 16; J.J. Verm., Orch. Mon. 7 (1993) 107 (in synonymy). —TYPE: New Guinea, *Gilli 566* (holo W)

Notes: Based on the description of *Bulbophyllum equivestigium*, Vermeulen (1993) incorrectly synonymised it with *B. muscicola* Schltr. Now that the type is available at W, it is clear that *B. equivestigium* is identical with *B. cylindrobulbum*.

Reference

Vermeulen, J.J., 1993. A taxonomic revision of the genus *Bulbophyllum*, sections *Adelopetalum*, *Lepanthanthe*, *Macrouris*, *Pelma*, *Peltopus* and *Uncifera*. *Orchid Monographs* 7: 1–324.

Book Review: Soepadmo, E., L.G. Saw and R.C.K. Chung, (eds.). 2002. **Tree Flora of Sabah and Sarawak. Volume 4.** Sabah Forestry Department, Forest Research Institute Malaysia, Sarawak Forestry Department. xii + 388 pp. ISBN 983-2181-27-5 (Vol. 4). Price: RM 100 or US\$ 100.

The ambitiousness of this project should not be underestimated. Northern Borneo contains, for its area, the largest lowland tree flora of anywhere in the Old World, and possibly anywhere. When the work is completed, the 75,000 square miles of Sabah and Sarawak may have been found to contain in excess of 5,000 tree species. This is the first flora for a major region of Borneo. Merrill's *Bibliographic Enumeration of Bornean Plants* (Journal Straits Branch Royal Asiatic Society, Special Number, 1921), extended by Masamune (*Enumeratio Phanerogamarum Bornearum*, 1942) contains but a rudimentary and outdated base. The regional *Flora Malesiana* provides an invaluable foundation, but hardly more than one third of the families have yet been treated by that great enterprise, while a close regional scrutiny is permitting more discriminating taxon recognition. Tim Whitmore, K.M. Kochummen and Francis Ng's groundbreaking *Tree Flora of Malaya* (Longmans, 1972-89), which treated just under 3000 species over 24 years, was based on a vastly greater previous botanical corpus including King's *Materials for a Flora of the Malay Peninsula* (1896) and Ridley's *Flora of the Malay Peninsula* (Reeves, 1922-25).

At a time when biological research in Malaysia is somewhat in the doldrums, Engkik Soepadmo and his colleagues are succeeding, overall, in a genuinely indigenous enterprise while determinedly holding to international standards. They have used the Flora project to train a new cadre of taxonomists, who have contributed many of the families. The editors are also committed to meet the needs of both professional taxonomists and the wider professional and public user, by minimizing technical jargon, by including identification keys primarily or entirely based on readily observable characters, and by providing summary information on ecology and uses.

Overall, while recognizing that shortcomings in a project with such ambitious goals are inevitable, the editors have succeeded to a remarkable extent. To my knowledge, no comparable indigenous project for a field-based and user-friendly critical flora has been undertaken elsewhere in the tropics. Particularly commendable are the keys, which, to varying extent admittedly according in part to the field knowledge of the authors, put major emphasis on vegetative over reproductive characters. This is vital for a region in which flowering among canopy trees fluctuates vastly between years, and in which reproduction is often scant for at least half the year.

The insistence on citation of types, and on substantiating species concepts and geographical range by citation of selected specimens, provides an invaluable test of rigour. High quality whole page botanical illustrations of selected species from each genus are provided. There are indices to both vernacular and scientific names.

Volume 4 is dedicated to our late friend and colleague Tim Whitmore; the gracious dedication identifies Tim as both creative spirit and driving force behind the *Tree Flora of Malaya*, which provided the model for the current flora. This volume includes treatments of 6 families, 24 genera and 321 species: of the latter, 45 (14%) are new to science, thereby indicating the inadequate extent of previous knowledge in spite of the achievements of *Flora Malesiana*. Overall, 47% of the species treated are endemic to Borneo and just under half of these are endemic to Sabah and Sarawak, offering dramatic evidence of the validity of northern Borneo as a global biodiversity hotspot. Four of the families, including the three largest, are authored by Malaysian specialists.

The true test of the quality of a flora must be by its use in the field, as well as the herbarium. This reviewer knows the families treated as a naturalist rather than a specialist, and it would be presumptuous to offer a detailed critique before my next visit to the field.

Ebenaceae, by Francis Ng, includes the 75 ebonies of Sabah and Sarawak. An informative introduction provides, after generic definition, extensive details on geography, ecology, biology and uses, and is clearly the work of someone who knows his material as living organisms. Curiously, bark and architecture descriptions are hidden within a section on taxonomy rather than under the generic definition. The key relies substantially on fruit, as well as vegetative characters, but not at all on flowers. This implies that vegetative characters alone are insufficient. It would have been useful to have included discussion of the best means to distinguish the most vegetatively similar species in footnotes under their descriptions, if impractical in the key. Previously recognized subspecies have often been suppressed. For instance it may be, as the author states, that continuous variation between *Diospyros sumatrana* subspecies *decipiens* and *sumatrana* exists in the herbarium, but my experience is that they are sufficiently distinct both in habitat and morphology in the field to merit sustainment as subspecies. More discussion of such variation, which seems to occur in several *Diospyros*, would have been useful even if a conservative decision is finally made. Overall, though, I found this to be a masterly treatment, and an excellent spur for us field biologists to further advance knowledge of the family.

Sapotaceae, with 11 genera and 121 species in Sabah and Sarawak, is treated by a team of eight botanists: seven from the Sarawak Herbarium, Kuching, and Joan Pereira from Sandakan Herbarium, under the overall editorship of Paul Chai and P.C. Yii at Kuching with varying but clearly substantial input from senior editor Engkik Soepadmo. Sapotaceae is a notoriously difficult family sharing, with Lauraceae, complex and difficult generic definition, which must rely on reproductive characters. The treatment suffers from the substantial disadvantage, therefore, of having a generic key that starts with and continues to use reproductive characters at major divisions, preventing its use in field ecological and other surveys. In my experience, at least the majority of entities are recognizable in the field, albeit not through resort to generic characters. I remain convinced that an additional key to all 121 species, based on field and if necessary ecological characters, would have been feasible. Of the larger genera *Madhuca*, 47 species treated, is by Yii and Chai; *Palaquium*, 41 species, by Abang Mohtar with assistance from Soepadmo. *Payena*, 12 species, by Pereira, and *Pouteria*, 7 species, by Stephen Teo. In all, seemingly workable keys are provided, based mostly or entirely on vegetative characters. Intraspecific categories, we are informed, are eliminated, being either raised to species rank or rejected; but nowhere in this family treatment are taxonomic explanatory footnotes provided beneath the species descriptions: these could have also helped overcome difficulties presented by the problematic generic key. It does seem curious that species new to science are described only in the quite small genus *Payena*, with a remarkable 5, and *Madhuca*, with 7. This might reflect differing species concepts among the authors, alternatively differing knowledge and attention to detail: the texts overall suggest the latter.

Oleaceae, with 6 genera and 47 species by Ruth Kiew, is a masterly account of a family that is the author's speciality. Again, it appears not to be possible to reliably identify the three tree genera *Chionanthus*, *Ligustrum* and *Olea* on vegetative characters. Some explanatory comments would have again been helpful here: Do not the inflorescences, or at least their abscission scars, remain on the twigs? The species descriptions are particularly clear in this family and brief footnotes are often provided, though rather little is offered on ecology. This author alone described new species and combinations with extensive taxonomic notes in a useful appendix in the volume

The treatments of the remaining, small, families are all competent. Aquifoliaceae, by Susyn Andrews, has a valuable introductory field key. There is no habit description of *Ilex*, nor allusion to the distinctive upper surface of the dry leaf. As might be expected from an author from outside the region, the ecological information is variable. Lecythidaceae, by Michelle

Pinard, is serviceable, with keys primarily relying on field characters. It had the advantage of Hans Payens' prior treatment in *Flora Malesiana*. I find *Barringtonia* species often difficult to identify; more footnotes would have been welcome. Proteaceae, by Richard Chung, aided by Hans Sleumer's treatment in *Flora Malesiana*, provides a competent and clearly useable account of this rather easy family, enriched by a surprising number of novelties.

Peter S Ashton,

Arnold Arboretum,
Harvard University, USA.
and
Royal Botanic Gardens,
Kew, UK.

Book Review: Evans, T.D., K. Sengdala, O.V. Viengkham and B. Thammavong. 2001. **A Field Guide to the Rattans of Lao PDR.** Royal Botanic Gardens, Kew, U.K. 96 pp. ISBN 1-84246-009-0. Price: 15 GBP.

Rattans are one of the most important forest products in generating income for local communities, but in spite of their long history of usage, many countries still do not have books that enable rattans to be reliably identified. With the rapid rate of forest exploitation, it is critical to know which species are the most valuable, how widely distributed they are, and whether they have potential for cultivation. For this to be possible, the first step is to know the scientific name of each rattan and this is what this field guide aims to do.

This little book has taken a new direction in rattan research in producing a user-friendly guide that is attractive and easy to use by a wide range of readers from the botanists to the local forester, agriculturalist or conservationist. Solidly based on both fieldwork and scientific herbarium research, it combines a great deal of information into an attractive format. It begins with a general section on basic information on rattans, which is followed by field keys and the heart of the book, information on the 31 main species and 20 similar allied species found in Lao and the surrounding region. The book finishes with an illustrated glossary of terms, which makes the often alien structures and terminology peculiar to rattans easily understood, advice on how to collect these spiny plants, the management and conservation of rattans, and a section on planting and cultivating rattans.

Particularly useful are the novel field keys set out like a spreadsheet so that it is possible to compare several characters simultaneously rather than being confined to the usual dichotomous keys that many non-botanists find uncomfortable to use. In fact throughout the book, careful thought has been taken to explain how taxonomy works and to give helpful advice on how to go about identifying plants.

The 31 Lao species are each given a double spread that includes a colour map to show its distribution within Lao and the surrounding region, as well as the distribution of similar species, and a colour photograph of the living stem and leaf sheath. Information includes the scientific and vernacular names, key diagnostic characters and other characters to look for when identifying them, its habitat, phenology, uses, cultivation and a description illustrated by line drawings. A box entitled 'Compare' includes similar or allied species and their diagnostic characters, which provides a quick way of checking the differences between similar species. The clear layout makes it easy to see the salient characters of each rattan.

It would have been more helpful to have included the glossy in the

introductory section so that a quick glance through would familiarise the reader with the various structures before attempting identification. I also found the terminology 'equivalent, alternative names' confusing. Are these synonyms? Elsewhere the intricacies of taxonomy have been very simply explained, why not here? It would also be clearer to include synonyms in the checklist of species indicating to which species they belong.

This is really a landmark publication and it will have wider use in the neighbouring countries of Thailand, Cambodia and Vietnam, where similar publications are not yet available. It is also a model for other user-friendly guides for the non-specialist besides setting a new trend of involving local botanists in its production, so that the project has not only produced a publication but has also encouraged local expertise. This latter is essential if rattans are to have a future, either from the viewpoint of their sustainable production or their continued existence.

Ruth Kiew

Singapore Botanic Gardens

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Stone, B.C. 1994. Additional notes on the genus *Glycosmis* Correa (Rutaceae). *Gardens' Bulletin Singapore*. 46: 113-119.

References to books and monographs should be cited according to the following form:

Ridley, H.N. 1930. *The Dispersal of Plants Throughout the World*. L.Reeve, Ashford, Kent.

For literature citations in taxonomic papers the following style is required:

Medinilla alternifolia Blume, Mus. Bot. Lugd.-Bat. I:2 (1849) 19.
Sterculia acuminatissima Merr., Philip. J. Sci. 21 (1922) 524.

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